

Splitting Atoms, Fracturing Landscapes:
Policymaking, Environmental Science, and the Nuclear Complex, 1945-1960

BY

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ABSTRACT
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“Splitting Atoms, Fracturing Landscapes: Policymaking, Environmental Science, and the Nuclear Complex, 1945-1960” examines the implications of an expansive nuclear culture in the postwar United States. This dissertation probes the intersection of Cold War policymaking, environmental science, and the nuclear complex—a shorthand way of discussing the sum set of all nuclear technologies in conjunction with the societal structures and ideologies necessary to implement such technology. Studying a unified nuclear complex corrects for the limitations associated with studying all nuclear technologies as separate entities, something that has created fractured understandings of how splitting the atom affected both natural and human systems.

This dissertation shows how U.S. policymakers in the early Cold War interacted with the environment and sought to fulfill their charge to protect the United States and its people while still attempting to ensure future national prosperity. Thus the consideration of an holistic nuclear complex better explains how humans, policy, technology, and the environment intermingled during the Cold War and profoundly affected not only the natural world, but also the human relationship to it. Weather, agriculture, geology and other natural factors have too long been absent from histories of nuclear technologies, and thus we have missed what splitting the atom truly meant. Ultimately, “Splitting Atoms, Fracturing Landscapes” prompts us to employ a more nuanced understanding of the interaction between human societies, governmental mandates to protect citizens and lands, and the natural world.

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Introduction

In August 1958, Donald A. Pugnetti, Managing Editor of *The Tri-City Herald* (“The Voice of Southeastern Washington”), sent a letter to White House Press Secretary James Hagerty. The letter itself seems fairly inconsequential in hindsight, but worth noting is that it was printed on the back of a hand drawn map of the area surrounding the Hanford Atomic Works plant (see Figure 1).¹ That map situated the Hanford plant in the midst of a variety of both industrial centers as well as natural and agricultural elements—the Columbia and Snake Rivers, wheat farms, an apple orchard, etc. While it is possible that Pugnetti merely found a piece of scrap paper on which to type his letter, it seems more likely that the graphical representation meant something to him and helped convey a sense of how he thought about the area, especially the relationship between the Hanford Atomic Works plant and its surrounding environs.

The map of Hanford also serves as an apt representation of the interconnectedness between the environment and the development of nuclear energy, even if such connections have frequently gone unnoticed by both scholars. Historians have done a fine job chronicling nuclear energy and its products on many grounds—political, cultural, military, just to name a few. Scholars have not been as successful, however, in evaluating how the interplay between environmental science and policymaking affected such nuclear developments. This oversight represents a significant lacuna in understanding nuclear history and the early Cold War and must be reconciled if we are to understand fully what nuclear fission meant at the time.

¹ DDEL, White House Central Files, General File, Box 1214, Folder 155, 1958, Letter from Donald A. Pugnetti to James Hagerty, 16 August 1958.

This dissertation looks at what I have termed the nuclear complex, scientific knowledge about the environment, and policymakers and argues that the environment and knowledge about it were pivotal forces in the nuclear complex's development. It considers the *environment* to be the non-human natural world, including not just biotic entities like plants and animals but also abiotic phenomena such as winds, weather, and rocks. I use the term *nuclear complex* as a shorthand way of discussing the sum set of all nuclear technologies in conjunction with the societal structures and ideologies necessary to implement such technology. Historians have hitherto typically considered nuclear technologies like nuclear power reactors and nuclear weapons as separate entities, but until these are understood as different facets of the same gem we will not truly understand how those in power made decisions about the nuclear complex. Policymakers had to make decisions about each at the same time, often knowing that a choice on one might affect the other (if nothing else, when budgeting), while the environment, especially scientific understandings of it, played a significant, yet underappreciated role in those decisions.

To accomplish such an investigation, this study uses three principal questions to help guide its organization. All of these address the reality that creating the nuclear complex inherently produced interrelated policy dilemmas, scientific problems, and philosophical questions about the place of technology in our societies. Moreover, each question is unanswerable without placing it in the context of the non-human natural world. Scientific understandings mediated how policymakers understood the natural world, but fundamentally these decision makers had to grapple with complex

environmental systems and how those interacted with equally complex socio-political and military systems.

First, *what does it mean to protect a nation?* Executive policymakers in the United States were fundamentally tasked with keeping the country and its citizens safe from harm. In the geopolitical context of the time, they perceived this to necessitate developing, maintaining, and improving a significant nuclear arsenal. Other nuclear technologies originated from the atomic bomb, and policymakers intended all of these to safeguard national interests in some way. But every nuclear technology also interacted with the natural world, sometimes to the detriment or at least potential detriment of human health. Thus the technologies that were intended to protect and improve the nation and the lives of its peoples in certain instances held the potential to cause great harm in others. Decision makers had to confront these realities when deciding, as was their charge, how best to protect the United States.

Second, *what are the limits and capabilities of nuclear technology (or any technology, for that matter)?* It is frequently difficult to discern exactly how a piece of technology will change human lives, but every inventor or scientist has some sort of hope for the technology he or she creates. No matter the intentions for nuclear technology, however, decision makers had to grapple with the realities such creations produced. Can a nuclear weapon keep a nation safe? Can nuclear energy help improve society in tangible ways? On the other hand, if nuclear technology could accomplish the goals set out for it, what unexpected outcomes did it also produce? Did those unexpected outcomes outweigh any real benefits produced by nuclear technologies? These questions are

difficult to pin down in hindsight, but were especially troublesome for policymakers to confront at the time.

Finally, *how should scientists and policymakers manage the unknown?* The contexts involved in this story—scientific, geopolitical, military, environmental, etc.—are fluid and difficult to master in any situation. When combined with new technologies, replete with all the uncertainties involved in developing and implementing such innovations, how did decision makers utilize existing intellectual networks to make policy about the nuclear complex? The answer clearly involved interpreting scientific understandings about nuclear technology and the environment as best they could, but the truth is that a great many questions were difficult to answer. Policymakers used science—environmental science in particular—to probe the unknown and best answer this study’s first two questions. How they did so can tell us more about the expansive nuclear culture in the postwar United States. Before continuing, laying out a few definitions can be a useful exercise.

This dissertation is primarily about conceptions of the natural world and *environmental science* much more than it is the actual spaces in which nuclear science and environment interacted. Luckily, defining what constitutes environmental science is much easier than defining what the environment or natural world actually is. Environmental science is a broad range of disciplines that includes, but is not limited to ecology, biology, chemistry, geology, and meteorology. Physics are also important, but in the nuclear complex this discipline played a very different role, used more to find better ways to harness nuclear energy than to understand the surrounding world. The spaces and beings those disciplines study—the “environment”—can be difficult to define. As

William Cronon wrote, “‘nature’ is a human idea, with a long and complicated cultural history which has led different human beings to conceive of the natural world in very different ways.”² For this dissertation, the environment is comprised of all natural features and creatures, all flora and fauna, along with the winds, waves, and earth. Some scholars have found it useful to distinguish between what is truly natural and a kind of “second nature” influenced and modified by humans. After humans detonated nuclear weapons, however, anthropogenic traces could be found in every ecosystem in the world, and thus trying to find a truly pristine environment since then has been impossible. In contrast, this dissertation eschews such distinctions and takes a less atomistic view. Using *environment* and *natural world* interchangeably, it considers the two to be the holistic set of non-human nature.

It is also useful to define the major players in the early history of the nuclear complex, the *policymakers* or *decision makers*. Focusing on the executive branch, the dissertation principally considers two sets of decision makers: the AEC Commissioners (the Commission’s top level administrators) and officials in the White House, especially presidents Truman and Eisenhower.³ To delve into AEC policymaking, the dissertation uses not only AEC archival records, but especially employs the AEC’s reports to Congress. Thus AEC policymaking included both what the Commissioners talked about in private and what they wanted to express to the public through Congress. In the White House, while Truman and Eisenhower were the most important actors, executive

² William Cronon, “Foreword to the Paperback Edition,” in *Uncommon Ground: Rethinking the Human Place in Nature*, William Cronon, ed. (New York: W. W. Norton & Company, 1995, 1996), 20.

³ On President Eisenhower’s place in the historiography, see, for example: Elmo Richardson, *The Presidency of Dwight D. Eisenhower* (Lawrence: The Regents Press of Kansas, 1979); Anthony James Joes, “Eisenhower Revisionism: The Tide Comes In,” *Presidential Studies Quarterly*, Vol. 15, No. 3 (Summer, 1985); Mary S. McAuliffe, “Eisenhower, the President,” *The Journal of American History*, Vol. 68, No. 3 (Dec., 1981); Donald Alan Carter, “Eisenhower versus the Generals,” *The Journal of Military History*, Vol. 71, No. 4 (Oct., 2007)

policymaking involved not only many presidential advisors, but also the many people who expressed their thoughts and opinions in things like letters, telegrams, briefings, and position papers to the presidents. Presidential policymaking, therefore, can be as narrow as Truman and Eisenhower or as broad as the many people with whom those presidents interacted. Hence, while the dissertation limits its scope by studying two specific groups of policymakers, these groups could be and often were quite diverse.

By taking an ecological approach to nuclear technology, research, and development and the incumbent policymaking, this dissertation revises our understanding of the presidencies of Harry S. Truman and Dwight D. Eisenhower, especially how administrators, including the AEC, thought about the environment and the nuclear complex. To support such a study, this dissertation principally examines nuclear testing, the fallout from that testing, nuclear test cessation talks during the Eisenhower era, atomic agriculture, and nuclear waste disposal. These topics not only demonstrate that the nuclear complex encompassed much more than nuclear weapons, but also allow for a broad consideration of how the environment and science about it affected nuclear complex policymaking. Those in power used environmental science to help make their decisions, and in doing so showed recognition both of how their decisions might affect the environment and for how they should modify their plans based on environmental realities, as these were understood. The environment mattered to nuclear complex policymakers, and both the Truman and Eisenhower administrations reflect a growing environmental awareness about nuclear science and how it could affect environmental welfare as well as human plans, desires, and wellbeing.

Early on in the development of the nuclear complex, defense officials remained fairly secretive on almost every facet of atomic energy. And yet, by the late 1940s even the public began considering the interaction between nuclear weapons and the environment. John Hersey's *Hiroshima* (1946) caused people in the United States to consider the effects radiation might have on biological entities.⁴ Other evidence for early understandings about the environment and the nuclear complex is provided by Hollywood movies like *Them!* (1954), which portrayed a nightmare scenario of how radiation might affect ants and turn them into mutated terrors the size of Volkswagens through long-term radiation exposure.⁵ Moreover, historian Ralph Lutts has suggested that Rachel Carson's seminal *Silent Spring* (1962) would not have had nearly the same effect on society had citizens not already been primed to think in distinctly ecological ways (especially about unseen forces) by concerns about radioactive fallout the previous decade.⁶ Clearly the environment mattered to the evolution of nuclear complex, even if most scholarship has not recognized it.

Even if scholars have not paid enough attention to the historical interactions between science, the natural world, and the nuclear complex, many good historical works do exist on various facets of the nuclear complex. Sixty years after the detonation of the first atomic bomb, historian Andrew Bacevich declared, "More than America's matchless material abundance or even the diffusion of pop culture, the nation's arsenal of high-tech

⁴ Hersey's work started as a single issue of the *New Yorker*, but soon became a monograph. John Hersey, *Hiroshima* (New York: Bantam Books, Inc., 1946, 1981)

⁵ *Them!* was Warner Brothers' highest grossing film of 1954 and a bona fide box office hit. William M. Tsutsui, "Looking Straight at *Them!* Understanding the Big Bug Movies of the 1950s," *Environmental History*, Vol. 12, Iss. 2 (April 2007), 237. It should be noted that Tsutsui's final argument is that these radioactive bug movies of the 1950s and early 1960s less represent fears of the nuclear complex, the Cold War, or humanity's lack of control of nature, but instead are about how bugs can be scary and many people at the time were terrified of actual insect invasions as warned by many entomologists of the time.

⁶ Ralph H. Lutts, "Chemical Fallout: Rachel Carson's *Silent Spring*, Radioactive Fallout, and the Environmental Movement," *Environmental Review: ER*, Vol. 9, No. 3 (Autumn 1985), pp. 210-225.

weaponry and the soldiers who employ that arsenal have come to signify who we are and what we stand for.”⁷ If one were to believe Bacevich, nuclear weapons would then seem to characterize the nation’s culture more than any other technology under its control. And yet, historian Lawrence Keeley has argued that after World War II, the atomic bomb’s mushroom cloud symbolized the “newly discovered madness of war.”⁸ The two statements are not necessarily antithetical—nuclear weapons occupy a complicated place in the United States and have since humans first harnessed the power of the atom. For example, nuclear bombs both were instrumental in the United States’ prosecution of the Second World War and represented among the greatest horrors of that conflict—from the outset, the bomb could be anything from savior to horseman of the Apocalypse, from guardian angel to demonic terror, depending on one’s perspective. The historiography of the nuclear complex is just as varied as human reactions to that technology.

Nuclear weapons have, unsurprisingly, elicited more study than any other aspect of the nuclear complex, and not just because these cost the United States over six trillion dollars between 1943-1998.⁹ Culturally, the bomb shook the United States in ways that were as sweeping as they were unpredictable.¹⁰ Other histories have chronicled nuclear

⁷ Andrew J. Bacevich, *The New American Militarism: How Americans Are Seduced by War* (New York: Oxford University Press, 2005), 1.

⁸ Lawrence H. Keeley, *War Before Civilization* (New York: Oxford University Press, 1996), 165.

⁹ When adjusted for 1996 dollars, the total came to \$5.821 trillion. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940*, Stephen I. Schwartz, ed. (Washington, D.C.: Brookings Institute Press, 1998)

¹⁰ Paul Boyer asserted, “It is as though the Bomb has become one of those categories of Being, like Space and Time, that, according to Kant, are built into the very structure of our minds, giving shape and meaning to all our perceptions.” Paul Boyer, *By the Bomb’s Early Light: American Thought and Culture at the Dawn of the Atomic Age* (New York: Pantheon Books, 1985), xviii. Whether atomic weapons have become a part of humans’ collective consciousness is debatable, but that the bombs have had incredible effects is not. In *By the Bomb’s Early Light*, Boyer first delved into the cultural effects of the bomb, and he continued that research into “intense and continuing impact on American consciousness and culture” of the Cold War and the nuclear arms race in *Fallout*. Paul Boyer, *Fallout: A Historian Reflects on America’s Half-Century Encounter with Nuclear Weapons* (Columbus: Ohio State University Press, 1998), xii. Robert Jacobs continued the conversation with *The Dragon’s Tail* and argued that stories were essential to understanding

weapons from the first detonation at Trinity to the bombing of Hiroshima, and also studied the lives of crucial figures in the nuclear complex, such as J. Robert Oppenheimer, sometimes called the father of the atomic bomb.¹¹ Still other scholars have questioned the unexpected dangers of nuclear weapons and asked whether the bombs have exacted a physical price on human bodies.¹² Yet few histories have evaluated the interaction between the environment and nuclear weapons, with most of those studies staying limited to the subject of nuclear fallout, which is as much of a human health issue as it is environmental.¹³ (This dissertation considers that human bodies are discrete from the natural world, even if surrounding environments have an important effect on human health.) The environment played a crucial role in both the development of the nuclear complex and how it affected humans. Even though historians have probed nearly every

how nuclear weapons affected the nation. Since most people had never seen a bomb, it was these narratives that formed their opinions of the bomb. Robert A. Jacobs, *The Dragon's Tail: American's Face the Atomic Age* (Amherst and Boston: University of Massachusetts Press, 2010)

¹¹ Ferenc M. Szasz, *The Day the Sun Rose Twice: The Story of the Trinity Nuclear Explosion, July 16, 1945* (Albuquerque: University of New Mexico Press, 1985); J. Samuel Walker, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan* (Chapel Hill: University of North Carolina Press, 1997, 2004); Kai Bird and Martin J. Sherwin, *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (New York: Alfred A. Knopf, 2005)

¹² Very critical of nuclear weapons and the people who tested them are: Phillip L. Fradkin, *Fallout: An American Nuclear Tragedy* (Tucson: The University of Arizona Press, 1989); Richard L. Miller, *Under the Cloud: The Decades of Nuclear Testing* (New York: The Free Press, 1986) Barton Hacker took a much kinder view, claiming, "Those responsible for radiation safety in nuclear weapons testing under the auspices of the Atomic Energy Commission were competent, diligent, and cautious. They understood the hazards and took every precaution within their power to avoid injuring either test participants or bystanders. Testing, of course, meant taking risks, and safety could never be the highest priority. Those in charge sometimes made mistakes, but for the most part they managed to ensure that neither test participants nor bystanders suffered any apparent damage from fallout." Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947-1974* (Berkeley: University of California Press, 1994), 9. Debra Rosenthal has even probed the mindsets of those who work on nuclear weapons design. Debra Rosenthal, *At the Heart of the Bomb: The Dangerous Allure of Weapons Work* (Reading: Addison-Wesley Publishing, Inc., 1990)

¹³ Some of the works that have probed the environmental issues are: Mark D. Merlin and Ricardo M. Gonzalez, "Environmental Impacts of Nuclear Testing in Remote Oceania, 1946-1996," in *Environmental Histories of the Cold War*, J. R. McNeill and Corinna R. Unger, eds., (New York: Cambridge University Press, 2010); Lutts, "Chemical Fallout"; Also see, from the previous note, Fradkin, *Fallout*, Hacker, *Elements of Controversy*, and Miller, *Under the Cloud*. A work that examines both environmental and human health effects of nuclear weapons is: *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects*, Arjun Makhijani, Howard Hu, and Katherine Yih, eds. (Cambridge: The MIT Press, 1995)

aspect of the nuclear complex, studies including the natural world as an historical actor represent a regrettable void of knowledge that should be filled in by careful thought and research.

Other aspects of the nuclear complex have not received the same attention by scholars. Studies of the history of nuclear power tend to focus more on what harnessing the atom for electricity can tell us about other aspects of humanity, such as how expertise plays a role in our societies, the rise of environmentalism, or what reactors demonstrate about humans' relationships with technology.¹⁴ Scholarly works have also focused on how atomic energy helped develop scientific knowledge, especially modern ecological understandings that were founded on the research of brothers Eugene and Howard Odum.¹⁵ Other scholars have chronicled the ways the nuclear complex dramatically altered both the physical landscape of the U.S. West and also its culture.¹⁶

Nuclear historiography contains several important gaps, however, and this dissertation seeks to correct the limitations these have produced in scholars' historical understanding of the nuclear complex. As stated above, the environment has not received the attention it deserves, most likely because most scholars have seen little need to chronicle what they assumed was merely wanton environmental destruction. More particularly, attitudes about and understandings of the environment by policymakers in the 1940s and 1950s are virtually ignored scholars. Without consideration of the

¹⁴ Brian Balogh, *Chain Reaction: Expert debate and public participation in American commercial nuclear power, 1945-1975* (Cambridge: Cambridge University Press, 1991); Michael Bess, *The Light-Green Society: Ecology and Technological Modernity in France, 1960-2000* (Chicago: The University of Chicago Press, 2003), Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge: The MIT Press, 1998, 2009).

¹⁵ See Chapter 6, "Ecology and the Atomic Age," in Joel B. Hagen, *An Entangled Bank: The Origins of Ecosystem Ecology* (New Brunswick: Rutgers University Press, 1992)

¹⁶ Dan O'Neill, *The Firecracker Boys* (New York: St. Martin's Press, 1994); *The Atomic West*, Bruce Hevly and John M. Findlay, eds. (Seattle: University of Washington Press, 1998)

interaction between the natural world and policymaking we cannot understand the nuclear complex because we will not understand the driving forces behind its development. Most importantly, the structure and focus of preceding works has been almost antithetical to the realities of an integrated nuclear complex. While writing a complete history of the nuclear complex in one book would be impossible, previous scholars have done little to acknowledge the interconnectedness of various nuclear technologies and processes.

A picture of the life cycle of radioactive ores can help illustrate the importance of taking a comprehensive and ecological approach to the nuclear complex (see Figure 2 for an AEC representation, even if flawed). The nuclear complex began with the procurement of nuclear ores through mining. Very similar to mining more traditional ores, this step would be useless without the means to process such rocks. In terms of the nuclear complex, the useful component of any mined ores only represented a fraction of the total extracted minerals (a 1949 estimate placed the ratio of uranium on the planet at roughly 6:1,000,000).¹⁷ Processing facilities turned that raw ore into useable fuel for implementation as both nuclear weapons and nuclear power production. Especially at these last two stages—processing and implementation—scientific research and development proved especially important, and advancing U.S. interests at these stages represented the bulk of what the AEC saw as its mission. Of course, each of these steps produced byproducts, some of which, such as radioisotope tracers, were usually produced intentionally and proved very useful in various research endeavors. Others, like

¹⁷ *Fifth Semiannual Report of the Atomic Energy Commission, January 1949*, 5. The U.S. government worked hard to help facilitate mining efforts, too. For example, the Federal Aid Highway Act of 1950 to add hundreds of miles of roads to create access to uranium producing districts, particularly on the Colorado Plateau. As of mid-1952, workers laid 783 miles of roads for this purpose at a cost of \$4,200,000 (around \$5,360 per mile). *Twelfth Semiannual Report of the Atomic Energy Commission, July 1952*, 3.

radioactive fallout from bomb tests or waste products from reactors, were less desirable, frequently dangerous both to ecosystems and human health, and necessitated cleanup or mitigation efforts to protect the nation. At all levels, the AEC oversaw the nuclear complex, even if its gaze typically focused on the nuclear complex's more charismatic elements, especially weapons and power development.

Hence, while each aspect of the nuclear complex may have seemed to develop independently, the truth is that the steps were interconnected, especially since the same men made decisions about the different facets of nuclear research and development and frequently did so at the same meetings. Those in power knew that the purification and production of nuclear ores in factories were reliant upon mining operations, and that both of those were necessary to develop nuclear weapons or nuclear power. And both scientists and policymakers recognized that every operation produced nuclear waste, either contained or free in the environment, which required studying and understanding so that the nation could deal with it. Radioactive minerals are central to each step and connect it to the others. The inclusion of scientific understandings about the environment into the historical narrative thus forces scholars to reevaluate how we have studied seemingly disparate nuclear technologies. Moreover, the ways policymakers used knowledge about the environment in their deliberations further underscores that any study of nuclear technologies must recognize that these are part of a larger unified nuclear complex, the development of which especially depended on the natural world. Perhaps most influential in this development of a broad nuclear complex, however, was the creation of the Atomic Energy Commission.

The first steps toward establishing the United States Atomic Energy Commission began in 1939 with the discovery of uranium fission by German chemists Otto Hahn and Fritz Strassman and early attempts by U.S. scientists to solicit funding from the federal government for nuclear research. War heightened such attempts, especially seen in the iconic letter from Albert Einstein to Franklin Roosevelt asking the President to look into ways “the element uranium may be turned into a new and important source of energy in the immediate future” and “to speed up the experimental work” currently being done at and funded by university laboratories.¹⁸ Roosevelt did follow Einstein’s advice for the most part and created the Manhattan Project, which was designed to produce the world’s first atomic bomb. To this end, in 1943, work started on significant nuclear processing and research plants at Oak Ridge, Tennessee, and Hanford, Washington. This research led to the first nuclear bomb detonation, the Trinity test on 16 July 1945, as well as the bombings of Hiroshima and Nagasaki, Japan on 6 August and 9 August 1945 respectively.

A mere day later, on 10 August 1945, Abe Fortas, the Acting Secretary of the Interior, sent a letter to President Harry Truman that emphasized how, even early on, policymakers recognized how many interconnected facets of the nuclear complex were important to the success of the others. That letter stated, “The recent use of radio-active mineral substances as an agency of destruction for war use and the strong possibility that they may be adapted to new and revolutionary uses in time of peace will undoubtedly

¹⁸ HSTL, Atomic Bomb Collection, Box 1, Folder Franklin D. Roosevelt Library--Copies of Correspondence Between Franklin D. Roosevelt and Albert Einstein [GHDC272], Letter from Albert Einstein to F.D. Roosevelt, 2 August 1939. Dr. Alexander Sachs actually delivered the letter to the White House on 11 October 1939, leading to FDR’s response a week later. HSTL, Atomic Bomb Collection, Box 1, Folder Franklin D. Roosevelt Library--Copies of Correspondence Between Franklin D. Roosevelt and Albert Einstein [GHDC272], Letter from Franklin D. Roosevelt to Albert Einstein, 19 October 1939

result in an intense search for and acquisition of lands containing such substances.”

Fortas thought that, because of this, such lands should not be permitted to fall into private hands in any way. The acting secretary then proposed that the President issue an executive order withdrawing all public lands containing such radioactive source materials from any sort of disposal availability to the public.¹⁹ A month later, President Truman signed executive order 9613 into existence, which withdrew all public lands and future lands of the United States that “contain deposits of radio-active mineral substances, and all deposits of such substances” from disposal under all public-land and mining laws.²⁰ Thus executive order 9613 highlighted two things: the U.S. nuclear program was highly dependent on radioactive ores, directly tying the fate of nuclear research to the land and the materials that could be mined from it, and the development of a nuclear complex of sweeping extent began to develop fairly early in the country’s nuclear program.²¹ Moreover, the United States’ search for radioactive ores not only spread out the U.S. nuclear complex across most of the globe, particularly into Africa, but also diffused the environmental costs of it as well.²²

¹⁹ HSTL, White House Central Files, Confidential Files, Box 4, Folder Atomic bomb and energy aug 45 to nov 49, 2 of 2, Letter from Acting Secretary of the Interior to President, 10 August 1945, 1.

²⁰ HSTL, Papers of Truman, President’s Secretary’s Files, Box 193, Folder Atomic Bomb 1945, Executive Order 9613, Withdrawing and Reserving for the Use of the United States Lands Containing Radio-Active Mineral Substances, 13 September 1945. A later executive order, 9908, added a clause to all land sales conducted by the United States that reserved for the United States the mineral rights for all radioactive ores contained in such lands. HSTL, Papers of Truman, President’s Secretary’s Files, Box 194, Folder Atomic Energy, Executive Order 9908, 8 December 1947

²¹ To emphasize the early and ever-increasing extent of mining in the nuclear complex during the studied period, two examples suffice: (1) As of mid-1952, workers had laid 783 miles of roads for the purpose of accessing radioactive ore deposits at a cost of \$4,200,000 (around \$5,360 per mile). *Twelfth Semiannual Report of the Atomic Energy Commission, July 1952*, 3. (2) When Eisenhower entered office, U.S. uranium procurement stood at 2,900 total tons each year (990 from the United States, 225 from Canada, and 1,685 from overseas). When Ike left office, that tonnage stood at 34,580 per year (16,565 from the United States, 13,445 from Canada, and 4,570 from overseas).

²² To emphasize the importance of radioactive ores, in 1953, Commissioner Thomas E. Murray claimed in a commencement address, “To my mind (to paraphrase Churchill), never was so much owed by so many to such a small amount of material [uranium] – deployed in the defense of freedom – material which the world was unaware of, so short a time ago, as when you graduates were in grammar school.” DDEL, White

After World War II ended, the United States attempted to transition its nuclear program from the Manhattan Project into the postwar with the Atomic Energy Act of 1946. Senator Brien McMahon introduced the bill in late 1945 and President Truman signed it into law on 1 August 1946 (the law went into effect on 1 January 1947). Principally, the Atomic Energy Act (also known as the McMahon Act) sought to establish civilian control of atomic energy in the United States and established the Atomic Energy Commission.²³ Even with such a mission, though, the AEC remained devoted to and heavily influenced by the military for much of the Truman and Eisenhower presidencies. The official AEC history of the period from 1947-1952 described how the nation transitioned from the secretive Manhattan Program, “completely isolated from the rest of American Life,” into the AEC of 1952 where “hundreds of nuclear scientists were receiving financial support from the Commission for research in their own laboratories, and private industry was beginning to take an active part in developing nuclear power.” Agency historians assert that, over the time period, an “inexorable shift [occurred] in the Commission’s aims from the idealistic, hopeful anticipation of the peaceful atom to the grim realization that for reasons of national security atomic energy would have to continue to bear the image of war.” In testament to that assertion, U.S. nuclear weapons research accelerated over Truman’s presidency (twenty-six of the thirty-one U.S. nuclear weapon tests from 1946-1952 occurred between 1951-1952). The U.S. nuclear program began with a focus on war as the

House Central Files, Official File, Box 213, Folder 8, Commencement Address by Thomas E. Murray at Seattle University, Seattle, WA, 29 May 1953, 2.

²³ All citations from the previous paragraph, other than the Einstein-Roosevelt correspondence, can be found here: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939/1946: Volume I of a History of the United States Atomic Energy Commission* (University Park: The Pennsylvania University Press, 1962), 5-7. Full text of the McMahon Bill/Atomic Energy Act of 1946 can be found pages 714-722.

Manhattan Project and remained devoted to developing nuclear weapons on the eve of Eisenhower's election.²⁴ As further evidence of this fact, President Eisenhower even said on the campaign trail in 1952 that the first responsibility of the AEC remained, in his mind, to "improve the atomic arsenal."²⁵

Other evidence for the military focus of atomic decision makers is easily seen in nuclear power production. For example, the world's first civilian nuclear power reactor, a 60,000-kilowatt plant located in Shippingport, Pennsylvania, did not go online until 1957.²⁶ On the other hand, military nuclear reactors had progressed much more quickly, as President Truman blessed the keel laying of the *USS Nautilus*, the world's first nuclear submarine, in 1952.²⁷ The *Nautilus*' maiden voyage occurred in January 1955, going 25,000 miles its first year, and by July 1957 the submarine had traveled more than 62,000 miles without refueling, over 36,000 of those submerged. A conventionally powered submarine would have required more than two million gallons of diesel fuel to accomplish such a feat—"enough to fill 217 tank cars making a train more than 1½ miles long."²⁸ Civilian nuclear reactors remained on a "horizon [...] far away" for Truman's

²⁴ The book contended the AEC Commissioners saw the nation's nuclear arsenal as an "atomic shield" against the dangers of the world. This can be seen, for example, in the title of Chapter Fifteen—"Science: Shield of the Free World?" Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947/1952: Volume II of A History of the United States Atomic Energy Commission* (University Park: The Pennsylvania State University Press, 1969), xiii, xiv, 672-673.

²⁵ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Campaign Series, Box 6, Folder Atomic Energy, "General Principles Regarding Atomic Energy Development," 1.

²⁶ *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 79-80.

²⁷ Truman claimed, "Her engines will not burn oil, or coal. The heat in her boilers will be created by the same force that heats the sun – the energy released by atomic fission, the breaking-apart of the basic matter of the universe." Moreover, he expressed hope for the future, saying, "This vessel is the forerunner of atomic-powered merchant ships and airplanes, of atomic power plants producing electricity for factories, farms and homes." HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder OF 692-A Atomic Bomb, Address by President at the Keel Laying of the First Atomic Submarine at Groton, Connecticut, 14 June 1952

²⁸ *Nineteenth Semiannual Report of the Atomic Energy Commission, January 1956*, 40. *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 48, 60.

presidency with significant issues of cost in comparison to conventional power plants.²⁹

Military reactors, in comparison, progressed much more quickly.³⁰

Over Eisenhower's presidency similar trends concerning the military nature of the nuclear complex continued, but Eisenhower era officials did make more of an effort to find and implement peaceful uses of atomic energy. Previous efforts existed toward beating the atomic sword into a plowshare, but Eisenhower's "Atoms for Peace" program advanced such plans.³¹ In a speech before the United Nations in December 1953, Eisenhower asserted, "It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace."³² Moreover, both his work on establishing an International Atomic Energy Agency and talks about nuclear test cessation reinforce that, while he certainly was not dovish, Eisenhower did not intend for the United States to be

²⁹ HSTL, Papers of Harry S. Truman, Official File, Box 1529, Folder 692-B (Mar.-Sept. 1950), Remarks of Commissioner Gordon Dean at New York University, "Horizons for Atomic Energy," 11 January 1950, 7. *Fifteenth Semiannual Report of the Atomic Energy Commission, January 1954*, 17.

³⁰ For another example of the time and research devoted to military reactors, see the work on nuclear-powered aircraft. The project continued during most all of President Eisenhower's term, even though, in April 1953, Secretary of Defense Charles Erwin Wilson ordered the program cancelled and subsequently called the nuclear plane a "shitepoke." "Shitepoke" is a colloquial name for a heron, so called for their tendency to defecate when scared into flight. HSTL, Papers of David D. Lloyd, General Correspondence File, Box 4, Folder Atomic Energy Commission, Chronology on Aircraft Nuclear Propulsion Program (ANP), 21 July 1959. Between 1946 and 1961, between 1946 and 1961, even with no viable airplane ever in sight, the U.S. military and Atomic Energy Commission (AEC) spent around a billion dollars on the project. When all the expenditures were calculated in 1996 dollars, the tally topped \$7 billion. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940*, Stephen I. Schwartz, ed. (Washington, D.C.: Brookings Institute Press, 1998), 123.

³¹ The idea that nuclear energy might be used in peaceful endeavors was not new to Eisenhower, of course. For example, in a late 1952 debate the United Kingdom's Minister of Works, David Eccles, coined the idea of "plutonium into plowshares." DDEL, Papers as President, Ann Whitman File, Speech Series, Box 5, Folder United Nations Speech 8 Dec 1953 (2), Intelligence Report No. 6500, "Official Foreign Reactions to President Eisenhower's Speech of December 8, 1953," 2. Project Plowshare took its name from the *Bible* (New International Version translation) verse Micah 4:3, which reads, "He will judge between many peoples and will settle disputes for strong nations far and wide. They will beat their swords into plowshares and their spears into pruning hooks. Nation will not take up sword against nation, nor will they train for war anymore."

³² DDEL, Papers as President, Ann Whitman File, Speech Series, Box 5, Folder United Nations Speech 8 Dec 1953 (1), "Atomic Power for Peace," An Address by President Eisenhower before The General Assembly of the United Nations, 8 December 1953, 11.

entirely a war hawk with its nuclear program. And yet Eisenhower's presidency remains complicated. Only a few months after Eisenhower's 1953 address on Atoms for Peace the United States detonated an unexpectedly powerful, hugely destructive thermonuclear weapon in the Pacific that manifestly altered the world's thoughts on the destructiveness of splitting the atom.³³ Eisenhower-era policymakers may have ardently believed in discovering and promoting the peaceful uses of atomic energy, but they also worked hard to improve the destructive potential of nuclear weapons.³⁴

Since so much of the history of the nuclear complex is fundamentally about U.S. efforts at developing military technologies, supplementing previously described scholarly works is a recent proliferation of historical literature on warfare and the environment that more broadly provides an intellectual framework for this dissertation. Edmund Russell's *War and Nature* prompted this explosion of study and argued for a coevolution of military and environmental factors over the twentieth century.³⁵ Other works, like William Tsutsui's "Landscapes in the Dark Valley" have more specifically probed the historical intersection of nuclear weapons, warfare, and the natural world.³⁶ In general,

³³ On popular opinion and that massive thermonuclear test, the 1 March 1954 Castle Bravo test shot, see contemporary newspaper articles that described how a Japanese fishing vessel, the *Lucky Dragon*, got swept up in the radiation from that test and how, "In any event the story seems to prove that the destructive potential of the hydrogen bomb has not been exaggerated." "The Unlucky Dragon," *The Washington Post and Times Herald*, 19 March 1954, page 28

³⁴ Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley: University of California Press, 1989) Some of the most impressive parts of the work are its nine appendices. These more than thirty pages range from giving lists of key AEC personnel to showing financial data, and also include flow charts on organization and the eight basic nuclear reactor systems developed. Pages 569-592.

³⁵ Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (New York: Cambridge University Press, 2001)

³⁶ Wartime Japan often was called the "dark valley" (黒い谷間—kuroi tanima), "a time of extreme deprivation and suffering." Tsutsui's essay tried to come to grips with that idea and argued, "Gaining a fuller understanding of Japan's complex and compelling wartime experience demands that closer attention be paid to the environmental policies, costs, and consequences of World War II." William M. Tsutsui, "Landscapes in the Dark Valley: Toward an Environmental History of Wartime Japan," in *Natural Enemy, Natural Ally: Toward an Environmental History of War*, edited by Richard P. Tucker and Edmund Russell, (Corvallis: Oregon State University Press, 2004), 195-196.

historians have reminded scholars of something that generals and foot soldiers alike have known for millennia—the natural world matters in warfare and must be taken seriously when conducting military history. Moreover, these scholarly works well demonstrate that times of war provide particularly brilliant flashpoints for understanding the intersection of humans, societies, and the natural world.³⁷ This dissertation adds to that literature by showing the importance of societal structures in the history of war and environment and attempting to broaden what that field studies. Before militaries ever get into the field, societies have made conscious decisions to organize their resources—human, natural, and economic—toward the purpose of making war (or at least being prepared to do so). We would be remiss if we did not study the processes by which that societal organization occurred and probe into the structures built for such purposes.

In addition to issues of policy, the nuclear complex, warfare, and the environment, this dissertation is also informed by questions about the nature of human interaction with technology. Official Atomic Energy Commission (AEC) historians Richard Hewlett and Oscar Anderson, Jr. claimed in 1962, “No other development in our lifetime has been fraught with such consequences for good or evil as has atomic fission.”³⁸ Of course, like

³⁷ In addition, this dissertation is particularly influenced by several other works concerning historical dimensions of war and the environment, including the full volume of Tucker and Russell’s *Natural Enemy, Natural Ally* and also: J.R. McNeill, “Woods and Warfare in World History,” *Environmental History*, Vol. 9, No. 3 (Jul. 2004); Lisa M. Brady, “The Wilderness of War: Nature and Strategy in the American Civil War,” *Environmental History*, Vol. 10, No. 3 (Jul., 2005); Chris Pearson, *Scarred Landscapes: War and Nature in Vichy France* (New York: Palgrave Macmillan, 2008); J. R. McNeill and Corinna R. Unger, eds., *Environmental Histories of the Cold War* (New York: Cambridge University Press, 2010); Chris Pearson, Peter Coates, and Tim Cole, eds., *Militarized Landscapes: From Gettysburg to Salisbury Plain* (New York: Continuum, 2010); Lisa M. Brady, *War Upon the Land: Military Strategy and the Transformation of Southern Landscapes During the American Civil War* (Athens: University of Georgia Press, 2012)

³⁸ Hewlett and Anderson, Jr., *The New World, 1939/1946*, ix. Of course, Jacques Ellul claimed that atomic energy, atomic weapons in particular, were neither good nor evil, but instead “necessary” due to the fact that the technology existed. He wrote, “It was, then, necessary to pass through the period of research which culminated in the bomb before proceeding to its normal sequel, atomic motive power. The atomic-bomb period is a transitory, but unfortunately necessary, stage in the general evolution of this technique. In the interim period represented by the bomb, the professor, finding himself with so powerful an instrument, is

any piece of technology, the determination whether splitting the atom has been a force for good or a force for evil certainly is in the eye of the beholder. Technology is, in its essence, entangled with culture and society in ways not commonly understood. As early as 1934, scholar Lewis Mumford declared that understanding technology “is not merely a first step toward re-orienting our civilization: it is also a means toward understanding society and toward knowing ourselves.”³⁹ Mumford’s most influential contribution has thus likely been his “insistence on technics as an expression of human personality.”⁴⁰ Mumford wrote before the creation of atomic weapons, and in light of such developments his proclamations can take on a very disheartening tone. No less optimistic, other authors have been much more circumspect about the place of technology in society, variously wondering whether machines have eroded moral values, dominated our decision making, or even run out of control and molded our societies.⁴¹

led to use it. Why? Because everything which is technique is necessarily used as soon as it is available, without distinction of good or evil. This is the principal law of our age. We may quote here Jacques Soustelle’s well-known remark of May, 1960, in reference to the atomic bomb. It expresses the deep feeling of us all: ‘Since it was possible, it was necessary.’ Really a master phrase for all technical evolution.” Jacques Ellul, *The Technological Society*, Trans. John Wilkinson (New York: Alfred A Knopf, 1964), 98-99.

³⁹ Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace and Company, 1934), 6. Of course, reviewer Rosalind Williams said that, while she used to like *Technics and Civilization*, upon rereading the work she decided, “Flashes of brilliant insight were nearly obscured by billowing clouds of pompous oratory, unsupportable generalizations, and smug self-absorption.” Moreover, after learning something about Mumford’s personal life, she thought, “I can no longer read the passages in *Technics and Civilization* that run on and on about ‘life insurgent’ as the creative force in history without recalling that Mumford justified his affair with Catherine Bauer as a period of disequilibrium necessary for him to achieve a new synthesis in his own life.” Rosalind Williams, “Classics Revisited: Lewis Mumford’s *Technics and Civilization*,” *Technology and Culture*, Vol. 43, No. 1 (Jan., 2002), 139-140.

⁴⁰ Williams, “Classics Revisited,” 140.

⁴¹ Jacques Ellul postulated some of these ideas in his seminal *The Technological Society*. He focused on “technique,” or “the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity,” finding that we are bound by technology like primitive humans were by rites and taboos. In fact, we are conditioned by the “technological civilization,” living in a world where “the most dangerous form of determinism is the technological phenomenon.” Ellul, *The Technological Society*, xxv, xxix, xxiii. Langdon Winner continued these ruminations with three principal ideas: 1) technology is not a neutral tool; 2) humans become slaves to technology as they create societal structures to house this technology; 3) humans become adapted and adapt societies to technologies (not vice-versa). In this way, we humans lose control of our own tools and are variously dominated by

It is clear, however, that science, with technology among its products, is what humans make of it.⁴² Put succinctly, science and technology are interrelated, and the effects of technology typically are socially constructed and dependent on human decisions.⁴³ Thus while Charles Perrow has claimed that some technologies are simply too dangerous to exist and will inevitably cause accidents, a better way to think about technology, especially atomic energy and its uses, is to consider these not to be dangerous in and of themselves, but instead only dangerous when humans themselves are.⁴⁴ The nuclear complex provides some of the more spectacular examples of technology humans

these. Langdon Winner, *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought* (Cambridge: MIT Press, 1977)

⁴² Spencer Weart claimed that his book, *Scientists in Power*, was about “the relationship within society between knowledge and power,” and yet even if “Knowledge is power [...] in our times the scientists who discover knowledge seldom control the power that results.” Spencer R. Weart, *Scientists in Power* (Cambridge: Harvard University Press, 1979), vii, 271. Harry Collins and Trevor Pinch elaborated on these ideas in *The Golem* and *The Golem at Large*. They said science is like the Jewish golem. Humans create science and it mostly follows our orders while growing a bit more powerful each day, but sometimes it can become a problem. They eventually decided that science “is not an evil creature but it is a little daft.” Harry Collins and Trevor Pinch, *The Golem: What You Should Know About Science, Second Edition* (New York: Cambridge University Press, 1993, 1998), 1-2. In this way, technology is the practical result of science within a society. “But science cannot rescue technology from its doubts. The complexities of technology are the same as those that prevent science itself from delivering absolutes; an experimental apparatus is a piece of technology and, looked at closely, the conditions seem as wild inside the lab as outside.” Harry Collins and Trevor Pinch, *The Golem at Large: What You Should Know About Technology* (New York: Cambridge University Press, 1998), 3.

⁴³ See Bijker’s *Of Bicycles, Bakelites, and Bulbs* on “the interlaced character of hitherto separate domains such as technology and society.” Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge: The MIT Press, 1995), ix. Also see Pacey’s *Meaning in Technology*, which argued that “a person’s ideals and values in relation to technology are an outcome of her or his sense of the purpose and meaning of life.” Arnold Pacey, *Meaning in Technology* (Cambridge: MIT Press, 1999), 3. Moreover, whether a piece of technology “succeeds” or “fails” is not “inherent in hardware but constructed by contingent social conditions.” Kenneth Lipartito, “Picturephone and the Information Age: The Social Meaning of Failure,” *Technology and Culture*, Vol. 44, No. 1 (Jan. 2003), 52.

⁴⁴ Perrow argued, “As our technology expands, as our wars multiply, as we invade more and more of nature, we create systems—organizations, and the organization of organizations—that increase the risks for the operators, passengers, innocent bystanders, and for future generations.” He continued by saying that no matter how many safeguards we include, “there is a form of accident that is inevitable.” Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (New York: Basic Books, Inc., 1984), 3. And yet, this tome on technology and risk assessment suffered from a flaw in conception, as Perrow ignored many technologies that are likely more dangerous over longer time periods—such as driving a car or eating food from a deep fat fryer—and instead focused on highly charismatic and exotic technologies such as nuclear power. Human life, in general, is a risky proposition, and while some technological systems may be so complex that they are ultimately somewhat likely to fail due to human error, a much greater percentage of automobile drivers will perish over their lifetimes than nuclear power users.

have created and thus serves as an excellent example to probe how technology interacts with human societies. This dissertation attempts to uncover more about how humans relate to the environment, technology, and each other.⁴⁵

Chapter One looks at the interplay between U.S. nuclear testing and environmental science. It argues that knowledge about the natural world played an integral role in how those tests transpired, but has not been recognized as such. More importantly, testing nuclear weapons caused executive policymakers to think more deeply about the environment and forced them to better integrate the natural world into their plans. Policymakers at the time understood the importance of the environment to nuclear tests even if they would not have always articulated their thoughts that way. Instead, these men talked about their concern for the weather and how tests affected and were affected by meteorological phenomena. Other concerns focused on the environs surrounding testing sites, especially animals and fish in the area. Knowledge about the environment thus proved crucial in U.S. testing. Decision makers did not show a desire to protect the environment absolutely when testing, but their actions do demonstrate an understanding of the relationship between the natural world and scientific research within the context of nuclear research and development.

The second chapter considers nuclear fallout. Humans discovered the phenomenon of radioactive fallout after the world's very first atomic blast at Trinity, but did not prove particularly concerned about it. The chapter shows that care and attention

⁴⁵ For more on the intersection of technology and the environment, sometimes called "Envirotech," see: Martin Reuss and Stephen H. Cutcliffe, eds., *The Illusory Boundary: Environment and Technology in History* (Charlottesville: University of Virginia Press, 2010); Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995); Edmund Russell, "The Garden in the Machine: Toward an Evolutionary History of Technology," in *Industrializing Organisms: Introducing Evolutionary History*, ed. Susan R. Schrepfer and Philip Scranton (New York: Routledge, 2004)

did increase over time, though, especially after two particularly dirty nuclear bomb tests—the 1953 “Harry” test shot during Operation Upshot-Knothole and the 1954 “Bravo” test shot during Operation Castle. As their considerations increased, so too did policymakers’ desires to control public understanding. The chapter contends that the ultimate lesson of nuclear fallout at this time, however, was that U.S. nuclear tests functioned as an integrated, massively uncontrolled, de facto experiment on the effects of radiation on ecosystems and human bodies. Officials did not recognize that experiment at the time. But by spewing radiation into the atmosphere, tracking the fallout as it came back down to the planet’s surface, and then studying the radiation’s effects after it entered ecosystems and human diets, policymakers nonetheless effectively sponsored such an investigation. In doing so, these unknowing experimenters greatly affected U.S. atomic policy and public responses to it.

Chapter Three looks at the culmination of events explored in the first two chapters—nuclear tests and the fallout these produced—and chronicles the international nuclear test cessation treaty talks conducted during the Eisenhower presidency. While the 1963 Partial Nuclear Test Ban Treaty that banned all tests in the atmosphere, outer space, and underwater is much better known, earlier talks proved critical to that agreement ever getting penned. Moreover, though the fact has gone mostly unnoticed, the environment and environmental science played crucial roles in these earlier talks. This chapter argues that worries about environmental contamination helped create a need for the talks, and the need for improved environmental knowledge became one of the primary negotiating strategies. Concerns about the natural world and knowledge about it thus mattered a great

deal in the talks, but have not been given their due notice by previous historians. This chapter seeks to correct that.

Chapter Four steps away from nuclear weapons of any sort and delves into how nuclear energy affected policymakers' considerations of agriculture. In showing how decision makers understood the relationship between the atom and agriculture, the chapter argues that atomic agriculture proved important to top decision makers because it gave them a chance to prove that nuclear energy did not necessarily mean nuclear weapons. Officials believed that agriculture could function as a completely peaceful vehicle for nuclear developments, both improving the nation and helping to feed the world as part of the Green Revolution. Decision makers wanted the public to think of such technological progress as hope for the future and not the red horse rider of the Apocalypse.

The fifth and final chapter studies understandings about nuclear waste disposal practices. Seeking less to chronicle those methods and more to explain a way of thinking, the chapter shows that policymakers did indeed care about radiation from radioactive waste and the environments into which that waste went, but did so in a manner consistent with contemporary understandings and practices of waste disposal. Fundamentally, concern about radiation from waste products occurred only after a default position typically declared that radioactive waste should be put into the environment somehow. Decision makers tended to think about nuclear waste just like they did any other refuse, except with the added problem of radiation. While those in positions of power did work to balance human and environmental health with the need to get rid of radioactive waste, they did so within an older framework of thinking about garbage that they could not

change. Moreover, understanding how decision makers thought about nuclear waste provides a window into waste disposal more generally and highlights an “out of sight, out of mind” mentality that did not fit a newer nuclear paradigm.

The conclusion, finally, revisits ideas about environmentalism, policymakers, and the nuclear complex. Once the reader reaches that point, however, it should already be clear that there is much more to the story of decision making about the environment and nuclear complex than has been told previously. It is easy to think that the environment and scientific understandings of it play little to no role in political and military decisions, but the nuclear complex shows that, at least in this case, such an interpretation is not accurate. Simply put, this dissertation, as part environmental history, part policy history, and part history of science and technology, charts a developing sensitivity to the intersection between the environment and the nuclear complex among mid-century U.S. policymakers. Environmental science was a crucial part of the nuclear complex during the Truman and Eisenhower administrations, especially in the minds of policymakers, and must be understood as such for us to best grasp what the nuclear complex meant for society then and today.

Chapter One

Whether the Weather: Nuclear Testing and the Natural World

“At the appointed time, there was a blinding flash lighting up the whole area brighter than the brightest daylight. A mountain range three miles from the observation point stood out in bold relief. Then came a tremendous sustained roar and a heavy pressure wave which knocked down two men outside the control center. Immediately thereafter, a huge multi-colored surging cloud boiled to an altitude of over 40,000 feet. Clouds in its patch disappeared. Soon the shifting substratosphere winds dispersed the now grey mass.”

—U.S. War Department description of the first atomic bomb detonation¹

At 5:30 in the morning on 16 July 1945, humans first harnessed the power of the atom in the form of a bomb. The test occurred at a “remote section” of the Alamogordo Air Base in New Mexico, well away from the public. One U.S. War Department press release described how, before the test, “Darkening heavens, pouring forth rain and lightning immediately up to the zero hour, heightened the drama.” That release also explained that the “ominous weather which had dogged the assembly of the bomb had a very sobering effect on the assembled experts whose work was accomplished amid lightning flashes and peals of thunder. The weather, unusual and upsetting, blocked out aerial observation of the test.” Thus, even though there was not “assurance of favorable weather,” the first atomic detonation occurred as scheduled.² The actual test itself (Figures 3 and 4) presented a terrifyingly striking and yet fascinatingly horrible spectacle, as the War Department’s description attested.³

¹ HSTL, Papers of Truman, President’s Secretary’s Files, Box 174, Folder Atomic Bomb, Press Releases [1 of 3], War Department Press Release on New Mexico Test Site, 3.

² Historian Ferenc Szasz even went as far to say, “If one examines the list of desired ideal weather conditions gathered from the group leaders and compares them with the actual conditions at the time of the July 16 shot, the contrast is striking.” Ferenc M. Szasz, *The Day the Sun Rose Twice: The Story of the Trinity Nuclear Explosion, July 16, 1945* (Albuquerque: University of New Mexico Press, 1985), 77-78.

³ HSTL, Papers of Truman, President’s Secretary’s Files, Box 174, Folder Atomic Bomb, Press Releases [1 of 3], War Department Press Release on New Mexico Test Site, 1-3.

From the very outset, then, natural forces played a considerable role in U.S. nuclear tests. Historian Ferenc M. Szasz claimed that scientists turned the entire Los Alamos Trinity site into “a sprawling, open-air scientific laboratory,” melding science and environment into an indistinguishable mass.⁴ The official War Department public release described the blast in relation to the natural world, particularly mentioning the weather and the mountains as a natural setting. In fact, weather had been a significant factor in the tests because summer thunderstorms could come upon the site so quickly and unexpectedly. Jack M. Hubbard, the chief meteorologist for the project, described how the operation date was “set from above,” and after that it became necessary to tailor the experiment to the expected wind and weather conditions. Moreover, questions existed about whether a blast would produce rain or affect the winds.⁵ Future nuclear tests would also influence and be influenced by the natural world.

This chapter probes the connections between executive decision making, understandings of the natural world, and nuclear weapons tests. In doing so it shows how the testing process inculcated a greater awareness among policymakers of the interconnection between the environment, science about it, and nuclear weapons testing, forcing them to think more deeply about natural factors in the context of testing their nuclear bombs. While this did not create a modern environmentalist ethos within executive decision makers, the interplay between the environment, scientific research, and national security did coalesce into a program of nuclear research and development that forced policymakers to consider the natural world when making their plans. When the United States conducted atomic bomb trials, environmental conditions not only

⁴ Szasz, *The Day the Sun Rose Twice*, 5.

⁵ Szasz, *The Day the Sun Rose Twice*, 67-74.

affected how those tests transpired, but also helped shape the scientific and political understandings produced by testing. Geology, geography, prevailing winds, and other natural features played a role in site selection, and the evidence of the different ways bombs affected the lithosphere, hydrosphere, and atmosphere not only influenced knowledge production, but also how military and political policymakers perceived and processed that information. Weather and prevailing winds proved particularly important and affected determinations about when and how tests could take place. Testing also created anxieties that the tests themselves might affect meteorological phenomena. Other concerns centered on what the tests did to the surrounding flora and fauna, particularly mammals and fish in the area. In short, the history of how the Atomic Energy Commission (AEC) tested the United States' nuclear arsenal demonstrates a connection between environmental science and nuclear bombs. Though historians have not noticed, U.S. nuclear testing is better understood when situated within an understanding of its relationship with the natural world and scientific understandings of it.

U.S. atomic weapons testing is typically understood as nothing but an environmental menace, and scholars have frequently mistaken lack of concern for environmental wellbeing for lack of attention paid to the natural world. For example, Historians Mark D. Merlin and Ricardo M. Gonzalez claimed, “most, if not all, [U.S. tests in the Pacific Ocean] were initiated with explicit political intention, often with little regard for the ecological consequences.”⁶ But such assertions run contrary to significant

⁶ Merlin and Gonzalez provide a catalog of both short and long-term, “direct and indirect atmospheric, geological, and ecological effects of nuclear testing in Remote Oceania.” These included obvious effects like atmospheric fallout and large bomb craters, but also lesser-known issues like how a large piece of coral reef broke off sometime between 1952-1958. Mark D. Merlin and Ricardo M. Gonzalez, “Environmental Impacts of Nuclear Testing in Remote Oceania, 1946-1996,” in *Environmental Histories of the Cold War*, J. R. McNeill and Corinna R. Unger, eds., (New York: Cambridge University Press, 2010), 167.

attention paid to environmental factors—meteorology, geology, ecology, biology, etc.—of areas in which tests occurred. Merlin and Gonzalez, like many historians before them, made a judgment based on the fact that U.S. officials did not have values similar to them about how policymakers should have protected the natural world from nuclear tests. It is not that the United States, in their words, had “little regard for the ecological consequences.” To the contrary, U.S. policymakers certainly cared about how tests might affect local ecology—those policymakers just did not prioritize environmental or ecological health. This chapter fundamentally argues that understanding how executive decision makers incorporated environmental understandings into their testing plans may not reveal a desire to protect the natural world, but it does show that environmental knowledge affected U.S. testing plans and mediated how bureaucrats interpreted those tests.

The natural world also played a significant role in producing the science understandings necessary for splitting the atom. Mark Fiege has argued that, before the United States ever detonated its first atomic bomb, atomic scientists held an “intense fascination with nature” that helped inspire them to produce the prerequisite knowledge necessary for creating the atomic bomb. Contrary to what popular opinion may be, Fiege claimed that this knowledge production was not merely “heartless men in white coats calculating on chalkboards and experimenting in laboratories.” Instead, the scientists who worked on the Manhattan Project held a reverence for nature and frequently spent time out in the natural world hiking and reflecting. Fiege chronicled how these men’s childhoods and adult experiences in the natural world heavily influenced and inspired their scientific research and demonstrated that “the nation’s atomic project, especially the

bomb, was deeply embedded in the human relationship to nature.”⁷ Connections between the bomb and the natural world did not end with the Manhattan Project, though, and instead continued throughout the history of the weapons, especially evident in U.S. testing.

Somewhat of a paradox exists in the history of nuclear weapons—although the most well-known nuclear blasts occurred during World War II, the bulk of atomic weapon detonations occurred as tests during times of relative peace. By the time World War II ended, the United States had detonated the world’s second and third nuclear bombs.⁸ President Truman learned of the first of these from a telegram, which informed him that reports on the “Big bomb dropped on Hiroshima [...] indicate complete success which was even more conspicuous than earlier test.”⁹ Of course, no matter how destructive these bombs were, they were not in actuality tests—the United States dropped these bombs as acts of war.¹⁰ In the succeeding years, the U.S. continued to test nuclear weapons to maintain and increase its nuclear superiority over the rest of the world, particularly the Soviet Union. The Soviets tested their first nuclear bomb in 1949, and

⁷ Mark Fiege, “The Atomic Scientists, the Sense of Wonder, and the Bomb,” *Environmental History*, Vol. 12, No. 3 (Jul. 2007), 578, 580, 584.

⁸ On the decision to drop nuclear bombs on Japan, see Walker’s *Prompt and Utter Destruction*. Walker argues, “In fact, however, Truman never faced a categorical choice between the bomb and an invasion that would cost hundreds of thousands of American lives.” Instead, the book claims Truman had five fundamental considerations in using the atomic bomb in warfare: 1) a commitment to end the war as soon as possible; 2) the need to justify the effort and expense of making the bombs; 3) desire to achieve diplomatic edge in the growing rivalry with Soviets; 4) a lack of incentives to not use the bomb; 5) a hatred of Japanese and desire for vengeance. J. Samuel Walker, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan* (Chapel Hill: University of North Carolina Press, 1997, 2004), 5, 92-96.

⁹ HSTL, Papers of George M. Elsey, Box 113, Telegram from Secretary of War to President, 6 August 1945

¹⁰ Some of the earliest appraisals of the atomic bombs dropped on Hiroshima and Nagasaki can be found here in the Strategic Bombing Survey. Most striking in it are the photographs of destruction wrought. HSTL, White House Central Files, Confidential Files, Box 4, Folder Atomic bomb and energy aug 45 to nov 49, 1 of 2, The United States Strategic Bombing Survey: The Effects of Atomic Bombs on Hiroshima and Nagasaki, 30 June 1946

after that U.S. testing became even more imperative from a military perspective.¹¹ U.S. nuclear tests occurred primarily at two locations—in the U.S. Southwest, like the world’s first tests, and at Pacific Ocean locations near the Marshall Islands (about 2,000 miles southwest of Hawaii). Those tests in the Pacific Ocean caused issues in the United States before they were even conducted.

Early concerns from about the United States’ first postwar tests were particularly manifested in fears of environmental damage. In November 1945, Congressman Schuyler Otis Bland (D-VA), chairman of the House Committee on Merchant Marine and Fisheries, sent a letter to President Truman expressing concern about possible environmental damage from planned tests both underwater and in the air above the Pacific (these tests eventually would be conducted in the summer of 1946 as Operation Crossroads). Bland worried that the experiments could carry “serious implications with regard to commercial fisheries” and destroy not only incredible amounts of fish, but perhaps whole fisheries. He continued, “Moreover, because of oceanic circulation the effects of any induced radioactivity might easily cause great harm to the aquatic resources over wide areas.” Therefore, Bland thought the War, State, and Navy Departments should contact the Department of the Interior to ensure that the selected testing locations would ensure as little damage as possible. He argued that Interior representatives should participate and view the effects of tests on marine life. Bland ended by saying that he could “see that an immense damage may be done if proper protection is not afforded the fisheries, and I sincerely trust that everything possible may

¹¹ As scholar Marek Thee has argued, “The history of the nuclear arms race is intimately interrelated with the systematic testing of nuclear weapons.” Marek Thee, “The Pursuit of a Comprehensive Nuclear Test Ban,” *Journal of Peace Research*, Vol. 25, No. 1 (Mar., 1988), 15.

be done to protect the fisheries of the world.”¹² Truman responded the next day with thanks for Bland’s letter, explaining that such tests were “only in the conversation stage so far.” The President also assured Bland that “every precaution will be taken if the experiment does take place to prevent any undue injuries to fish.”¹³ This statement, of course, makes us question exactly what sort of injuries the fish were due so that undue harm could be avoided.

Beyond concerns expressed in an official capacity, outcries appeared from both the public and Congress in opposition to U.S. tests on environmental and moral grounds. One newspaper article, titled, “Smoke From Vesuvius,” suggested possible disaster by describing how, “the atomic volcano over which the world lives is rumbling and smouldering.”¹⁴ Others, like a Mrs. M. Conan, wrote to Truman fretting over the possible damage to fish and the possibility that an atomic blast at sea might produce a tidal wave.¹⁵ Many other critics worried less about potential harm to pelagic fishing and more about the ethical problems associated with using animals as test subjects during nuclear weapons testing. An example of that concern can be seen in a letter from Congressman Vaughn Gary (D-VA) to the President.¹⁶ No matter why they protested, it is clear that

¹² HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder 692-A MISCELLANEOUS (Apr.-Oct. 1945), Letter Schuyler Otis Bland to Truman, 24 November 1945

¹³ HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder 692-A MISCELLANEOUS (Apr.-Oct. 1945), Letter Truman to Bland, 26 November 1945

¹⁴ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Newspaper clippings and Releases, “Smoke From Vesuvius,” *Dayton News*, 20 April 1948

¹⁵ HSTL, Papers of Harry S. Truman, Official File, Box 1528, 692-A Miscellaneous (Jan.-Apr. 1946), Letter Mrs. M. Conan to Truman, 3 April 1946 Mrs. Conan’s letter also contained vicious anti-communist sentiment, saying, “America you can’t make a pet out of communism. You will get badly stung if you try it! Communism is the anti-Christ.” She held up God as the best way to defeat communist threats.

¹⁶ All in HSTL, Papers of Harry S. Truman, Official File, Box 1528, Folder 692-A Miscellaneous (May-Dec. 1946), see: Letter Vaughn Gary to President, 17 June 1946, Letter R. Maxwell Bradner to President, 2 July 1946, Letter Rolf Kreitz to President, 2 July 1946, Letter Walter G. Gleassen to President, 9 July 1946. Several of these letters used explicitly religious reasoning for being against the use of animals during testing. Similar protestations against animals used during nuclear testing also occurred during the Eisenhower presidency. In particular, an article in the *Denver Post* about the AEC Division of Biology and

many U.S. citizens outside the executive branch expressed concerns to President Truman about how nuclear bomb tests would harm the surrounding biota and insisted that testing stop or be altered in order to minimize any possible damage.

In July 1946, in spite of such protest directed at the President, the United States did conduct its first postwar nuclear tests when it detonated two bombs in the Pacific Ocean on the Bikini Atoll, a small lagoon in the Marshall Island chain and the namesake of bikini-style bathing suits.¹⁷ Testers intended for this series, Operation Crossroads, to help show what a nuclear blast would do to ships and their crews, and therefore had ships docked in the atoll's lagoon, spread out at pre-determined distances. In addition to allowing the United States to conduct oceanic tests, Bikini also had the advantage of being several thousand miles away from the U.S. mainland. The first test of this Crossroads series, detonated on 1 July, was codenamed "Able" (Figures 5 and 6). By all accounts, this detonation went mostly as planned, other than going off 1,500-2,000 feet west of the assigned target. Its intensity "approached the best of the three previous atomic bombs," and it went off at the planned altitude, a few hundred feet above the sea. Many of the ships surrounding the blast showed considerable damage. Exposed personnel on those ships (had there been any) would have experienced high casualties, but those sheltered "would not have been immediately incapacitated by burns alone" no matter what happened later from the lethal doses of radiation they would have received. The

Medicine using dogs for experiments elicited a great many telegrams from Colorado. DDEL, White House Central Files, General File, Box 1213, Folder 155 1955, Various Telegrams, 26 April 1955

¹⁷ One of the funnier stories to come out of these tests centers around a journalist who, seeing the tests at Bikini that summer, asked if he had the security clearance to write about how the mushroom cloud produced at Alamogordo had been purple. After an argument ensued about the actual color of the cloud (it had been white), one of the security clearance personnel reminded the journalist that he had been wearing purple sun glasses the day of that test at Alamogordo. HSTL, Dean G. Acheson Papers, Box 2, Folder Atomic Energy, 1947-1948, Control of Atomic Energy, Address by H. Thomas Austern at NYU on 20 March 1948, Washington Square College Alumni, 1.

report on test Able said, “In general no significant unexpected phenomenon occurred, although the test was designed to cope with considerable variation from predictions. There was no large water wave formed. The radioactive residue dissipated in the manner expected. No damage occurred on Bikini Island, about three miles from the explosion center.” In general, the test went well enough that evaluators claimed, “the importance of large-scale research has been dramatically demonstrated.”¹⁸

Operation Crossroads also had a second test, codenamed “Baker,” held on 25 July that did have unexpected environmental phenomena. Baker (Figures 7, 8, and 9) was an underwater shot that caused gigantic waves that, even 1,000 feet from the center of the detonation, were 80-100 feet in height. The bigger problem, however, was the incredible and unexpected radiation from the test. The preliminary report on the subject to President Truman said, “Great quantities of radioactive water descended upon the ships from the column or were thrown over them by waves.” Such “highly lethal radioactive water” made it unsafe for any inspection teams to board the moored ships for over half a week. Thus, beyond the ships physically destroyed by the blast (testers used a similar setup to the Able shot), the surviving ships were effectively scuttled while still afloat. Telling the President that it was “impossible to evaluate an atomic burst in terms of conventional explosives,” the report generally described the Baker test as incredibly destructive. It summed up the radiation contamination of the ships by saying these “became radioactive

¹⁸ HSTL, Papers of Harry S. Truman, Official File, Box 1533, Folder 692-F The President's Committee to Observe the Atomic Bomb Tests, Press Release of Preliminary Report on 1 July 1946 Bikini Atoll tests, 11 July 1946 The animals that many people protested proved paramount in determining the radiation damage that would have been suffered by ship crews, as “Measurements of radiation intensity and a study of animals exposed in ships show that the initial flash of principal lethal radiations, which are gamma-rays and neutrons, would have killed almost all personnel normally stationed aboard the ships centered around the air burst and many others at greater distances.” HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder OF 692-A Atomic Bomb, Preliminary Report Following the Second Atomic Bomb Test, 30 July 1946, 1.

stoves, and would have burned all living things aboard them with invisible and painless but deadly radiation.”¹⁹

These two tests show an evolving understanding about the relationship between testing atomic bombs and scientific knowledge about the environment. Atomic bomb tests were, at their core, scientific experiments. Thus while the first test, Able, likely spewed radioactive materials into the air, airborne contamination went mostly unmentioned in reports because the experiment was not designed to measure for such. The radioactive water from the Baker shot, on the other hand, occupied a central place in analyses because its effects were readily detected within the existing experimental framework attempting to test for radioactive contamination of the moored ships.

Thus the different reactions to Able and Baker show the importance of environmental science to test evaluations. While evaluators might have been able to avoid talking about a radioactive column of air or minimize its effects in their reports because they did not detect it, a tidal wave of radioactive water proved too much to ignore, as the Committee to Observe the Atomic Bomb Tests estimated the radioactive watery spray covered 90% of the target array (docked ships and submarines surrounding the blast). The Committee asserted this was the equivalent to exposing the area to “many hundred tons of radium.” In addition, weather played an important role in judging experimental results. When evaluators deemed weather conditions for the Baker shot were “perfect,” they made a subjective judgment about the environment directly related to testing. In short, nuclear tests changed how testers evaluated the weather because tests caused experimenters to view meteorological reports through their aims and desires for

¹⁹ HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder OF 692-A Atomic Bomb, Preliminary Report Following the Second Atomic Bomb Test, 30 July 1946, 2-3.

nuclear tests. In addition, had weather conditions not been “perfect,” any test results would have been mediated through the less than perfect weather evaluation. After Operation Crossroads concluded, the Committee looked at the possible effects of nuclear bombs, especially including the nuclear tidal wave the Baker shot produced, and concluded, “the Bikini tests strongly indicate that future wars employing atomic bombs may well destroy nations and change present standards of civilization.”²⁰ In short, weather, water, and air were not merely the settings for nuclear weapons testing, but instead became the experimental mediums through which humans understood and evaluated the tests’ successes, failures, and possible impact on civilization and nations.

Of course, even though the importance of environmental knowledge to these tests is clear in hindsight, it does not mean that evaluators thought of either the tests or their reports in environmentalist terms. Instead, the assessments judged the incredible waves of radioactive water to be an “impressive result” of the Baker test and not necessarily an environmental phenomenon—the wave was more a scientific product than part of the natural world. The final report of the Joint Chiefs of Staff declared that the tests at Bikini “provided data essential to future military planning, giving bases for the calculation of the conditions under which the maximum destructive effects of an atomic explosion will be obtained against various types of land and water targets and against living organisms.” Testers had used live animals as test subjects on the moored ships during the tests, but even if effects on animal biology comprised an important aspect of the tests evaluators thought of how they were affected purely in military terms. The animals on those ships

²⁰ HSTL, Papers of Harry S. Truman, Official File, Box 1533, Folder 692-F The President's Committee to Observe the Atomic Bomb Tests, Report Carl Hatch to President, 29 July 1946, 1-3. On the Crossroads tests, also see HSTL, Papers of Harry S. Truman, Official File, Box 1533, Folder 692-G Joint Chiefs of Staff Evaluation Board, Preliminary Report Following the Second Atomic Bomb Test

did not necessarily represent living things, but instead future bomb targets. Just as bombing pilots frequently talk about “the hit,” but not necessarily the destructive aftermath of their bombs, test evaluators proved more concerned with effects on targets than they were with the natural world and creatures in it. This held true, even if listed among the possible peacetime values of the more than 30,000 pages of “detailed technical reports” were “the data relating to nuclear physics, medical phases of radiation, including military aspects of radiological safety, and those relating to oceanography, meteorology, and marine and island biology and geology.”²¹ To evaluators, nuclear testing sites were not spaces where nuclear technology interacted with the environment. Instead, they were open-air testing laboratories.

The AEC’s late-1940s establishment of “a proving ground in the Pacific for routine experiments and tests of atomic weapons” not only showed the importance of testing to the Commission, but also demonstrated how policymakers increasingly involved environmental knowledge in their decisions about nuclear tests. The Commission declared that tests “must be a routine part of any weapons program,” and the President later approved that statement for inclusion in an AEC report.²² The required characteristics for test locations melded geopolitical and environmental considerations. One summary listed those requirements: (1) protected anchorage 6 miles in diameter; (2) at least 300 miles from urban areas; (3) less than 1,000 miles from a B-29 base; (4) a region without “violent storms”; (5) “Predictable currents of known and great lateral and

²¹ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Testing, Crossroads, The Evaluation of the Atomic Bomb as a Military Weapon: The Final Report of the Joint Chief’s of Staff Evaluation Board for Operation Crossroads, 30 June 1947, 16, 19-21.

²² HSTL, White House Central Files, Confidential Files, Box 4, Folder Atomic bomb and energy aug 45 to nov 49, 2 of 2, Memo from D. E. Lilienthal to President, 18 July 1947; HSTL, White House Central Files, Confidential Files, Box 60, Folder Atomic Energy Commission, Cross Reference Sheet, re establishing a Proving Ground in the Pacific for routine experiments and tests of atomic weapons.” 19 July 1947

vertical dispersion. Good fast surface currents which avoid fishing areas, steamer lines and inhabited shores.”; (6) a certain minimum distance from continental U.S.; (7) an unpopulated area; (8) an area owned/controlled by U.S.; (9) a temperate tropical climate. In the end, as we know, planners decided on Bikini as the best area to fit into the qualifications. The resident “population [was] less than 200 and can be readily moved to another atoll” (whether they wanted to or not). And, in respect to Senator Bland’s wishes, the Department of Interior studied the location with respect to the effects tests there would have on fisheries.²³ Thus long before any tests ever occurred, in choosing their ideal testing site, policymakers explicitly considered the natural world and how bomb testing would affect environment and vice versa. This does not mean that they were environmental activists or truly concerned about the effects of nuclear tests on ecosystems, but it does mean that natural systems and features weighed heavily on their minds and influenced their decisions.

For larger tests, AEC higher-ups used environmental and scientific reasoning and eschewed Bikini Atoll in favor of establishing a permanent Pacific Proving Grounds at Eniwetok Atoll. The two locations are around 100 miles apart, both in the Marshall Islands chain. The AEC needed a “suitable” area to test bombs, and Eniwetok gained the nod because Bikini did not have the sufficient land surface to accommodate the instrumentation for proper scientific observations. Also, only 145 residents called Eniwetok home and “very important from a radiological standpoint, it is isolated and there are hundreds of miles of open seas in the direction in which winds might carry radioactive particles.” Thus Eniwetok’s natural features proved crucial for its selection.

²³ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Testing, Crossroads, Proposed Plan for Atomic Bomb Test Against Naval Targets

Not only did the Atoll provide enough land area, but it also held the geographic advantage of being far away from other peoples (its residents and their connection to their homeland were out of luck, though, in this health and safety calculus). A press release on Eniwetok's selection even declared, "All test operations will be under laboratory control conditions," meaning a few decisions and judgments on the Atoll's natural features could turn Eniwetok, in the minds of U.S. policymakers, into a laboratory.²⁴

The July 1950 semiannual report of the AEC showed the continued interaction between the natural world, testing, and environmental science. In 1948 the United States conducted a series of tests named Operation Sandstone at the Pacific Proving Grounds. Sandstone consisted of three nuclear test shots, and after each one, testers sent in tanks, remote-controlled from helicopters, to take soil samples for analysis. However, each time at least one tank bogged down in the soft soil and another one had to be sent in to do the first tank's job. After nearly a week, soil radioactivity declined enough that teams could be sent in to recover the stalled tank without excessive radiation exposure.²⁵ Those testing proved incredibly aware of the on-site radiation present after each nuclear blast, even if their primary concern certainly was about human health and not the condition of the environment. But even with concern for radiation, something as simple as soil density could throw off the plans of even the best-prepared evaluators.

In the fall of 1950, U.S. policymakers began discussions about conducting underground tests on Amchitka Island, located in the Aleutian chain, and these discussions further elucidate the connection between testing and the natural world.

²⁴ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy—Newspaper clippings and Releases, Press Release on the Establishment of Pacific Experimental Installations, 1 December 1947

²⁵ *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 119-122.

Though tests at the site would not happen until well after the end of Truman's presidency, discussions reached a critical enough stage that, on 30 October, Truman approved testing during fall 1951 at Amchitka.²⁶ Previously, a study of the eight atomic bomb tests to that date provided the United States with a great deal of information on the effects of bombs detonated at heights from 100-2,000 feet in the air and also, in the case of the Baker shot during Operation Crossroads, underwater as well. Yet even with all this information it became clear that testing had given no indication of what happened during an underground test. If the United States needed a penetrating atomic weapon to attack "particularly well constructed or deep underground targets," the data at hand would not be sufficient to construct such a device.²⁷ U.S. decision makers therefore decided that the country should conduct such tests and fill in this knowledge gap.

Site selection held particular importance in discussions of underground testing, and choosing a site for the test hinged on nine factors that combined issues of environment, politics, and logistics: safety, sovereignty, security, public relations, climate, geology, cost, accessibility, and size. While testers did not think that underground nuclear testing would be particularly dangerous (at least in comparison to other atomic tests), they still believed it should be done not in the United States, and that "Certain remote areas in Canada and other areas within the Commonwealth, such as Australia, offered some advantages." These remote Canadian sites made the cut over many other sites; the Caribbean had too many people, the Pacific Proving Grounds at Eniwetok did not have the correct size or geology, and evaluators discarded many

²⁶ HSTL, Papers of Truman, President's Secretary's Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from James S. Lay, Jr. to Secretary of State, Secretary of Defense, and Chairman of the Atomic Energy Commission, Subj: Underground and Surface Atomic Bomb Tests, 30 October 1950

²⁷ HSTL, Papers of Truman, President's Secretary's Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from James S. Lay, Jr. to President, 27 October 1950, 1-2.

Alaskan sites “because of inaccessibility, extreme climate, unsatisfactory geology and the considerable number of trappers and prospectors.”²⁸

In short, a combination of human factors, natural features, and geography intermingled to create the determining criteria for the site selection of this test. The selection of the eventual site on Amchitka shows this well, as “Careful consideration of the several isolated, uninhabited islands toward the outer end of the Aleutian Chain led to the determination that Amchitka Island is the only site that satisfies all of the established criteria to an acceptable degree.” Even though Amchitka was completely uninhabited (because the U.S. government had removed native inhabitants during WWII), the island had the infrastructure necessary for testing, leftover from WWII. Some factors grounded in the natural world worked against the site, though, such as the Department of the Interior’s strong desire to preserve indigenous wildlife and the island’s mostly “bad” climate. A selection memo further explained, “Rain and fog predominate in the summer and snow and high winds in the winter.” Such concerns could be worked around, however, as “For a short period in May and in a longer period in September and October, the weather can be expected to be moderate.” Hence even with a few environmental problems and security concerns because the island was so close to the Soviet Union, policymakers deemed Amchitka Island “the only site presently available that reasonably satisfies all the criteria established for the safe conduct of an underground and surface atomic test.” A report also noted that the airflow in the region from West to East meant that the USSR would not be able to detect the tests by radiological means. In this case, the site had prevailing winds working in its favor because national security was deemed

²⁸ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from James S. Lay, Jr. to President, 27 October 1950, 3.

more important than reducing the radiation exposure of U.S. and allied citizens.²⁹ In short, Amchitka, due to its geography and environment, represented the most ideal site for the United States' proposed underground tests.

Site selection at Amchitka was, however, challenged by significant criticism emerging from the Department of Interior site due to concerns about wildlife protection. Dale E. Doty, Assistant Secretary of the Department of the Interior, wrote that he and his department protested using the island for testing because it represented “the principal concentration center for the total existing population of sea otter which had been brought to near extinction during Russian occupation of Alaska and which is now being restored and re-colonized over a part of its former range under the close protection by the Fish and Wildlife Service.” U.S. officials used the Amchitka herd for stock as part of the transplanting and management program, and though there were otters elsewhere, since the herd had only increased on Amchitka the value of the site was clear. This is not to say that Doty believed in purely preservationist ideals—he also argued that the value of each otter pelt would average around \$1,000 each, with some topping \$2,500, and therefore keeping the site viable for otters would produce “revenue to the Government, once the resource is restored to a production basis, [of] hundreds of thousands of dollars annually.”³⁰ Like testing in general, concern for the environment did not necessarily mean a desire to protect it and the creatures in it from no harm.

Therefore, in Doty and the Interior Department's opinions, testing would be bad for several reasons, all related to the otter population. First, testing personnel entering the

²⁹ HSTL, Papers of Truman, President's Secretary's Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from James S. Lay, Jr. to President, 27 October 1950, 4.

³⁰ HSTL, Papers of Truman, President's Secretary's Files, Box 176, Folder Atomic Energy, Superbomb Data, Letter from Dale E. Doty to James S. Lay, Jr., 13 October 1950, 1.

site “would undoubtedly provide opportunity for the molesting and killing of animals.” Also, obviously, since the beaches of the island were situated within the danger area of the test, the blast itself, along with “falling debris, flash, and possibly direct radiation,” caused a good chance of harming the animals. The potential for long-lived radiation also worried the Department of Interior. Thus, from the standpoint of the Interior’s responsibilities toward the sea otter and waterfowl populations, “it would hardly have been possible to have chosen a more objectionable area than Amchitka.” Doty argued that certain provisions needed to be incorporated into test programs if the operations ever proceeded. All laws needed to be followed to ensure “the maximum possible protection of the sea otter from poaching or from any unnecessary disturbance or molestation,” and also the Fish and Wildlife service needed money to trap and transfer many otters over the winter to safer areas. The later would be costly and require “considerable logistic support” from the U.S. military. Even considering all these precautions, Doty still believed that the tests should happen elsewhere, as Amchitka was the only place otters had recovered as well as they had.³¹ Policymakers noted these objections, but at the end of the discussion decided to go on with the test and merely to work with the Department of the Interior “to preserve the indigenous wild life inhabiting the island.”³²

While managed otter populations alone could not deter those wanting to test on Amchitka, the area’s natural formations could. As the proposed fall 1951 testing date neared, reports surfaced that, though Amchitka still appeared to be the best possible site for the underground detonations, “detailed exploration of the site has revealed geological

³¹ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Letter from Dale E. Doty to James S. Lay, Jr., 13 October 1950, 2-3.

³² HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from James S. Lay, Jr. to President, 27 October 1950, 7.

conditions less favorable than preliminary surveys had indicated” that would reduce the accuracy of any data gained. This caused policymakers to rethink their plans and instead believe that perhaps a continental site might be better, as “More favorable geological and meteorological conditions are known to exist at several possible continental test sites than at Amchitka Island.” Ultimately, even though it was later used in a different test series, Amchitka was jettisoned for the Nevada Test Site with the recognition that a continental site would also clear up many logistics problems.³³

Thus the decision over testing on Amchitka Island shows a developing recognition of the importance of environmental factors and environmental science in the minds of AEC and White House decision makers. More importantly, it shows what they considered important. Less important were factors like sea otters or what might be perceived today as environmental health, at least in terms of what could be worked around and what could not. What was important, though, were aspects, both geological and broadly environmental, that might have influenced U.S. nuclear tests. Testers perceived the environment as a strength, for example, when the prevailing winds made it harder for the Soviet Union to detect and study the radioactive cloud a test might produce. But when scientific exploration uncovered unfavorable meteorological and geological conditions, these natural features caused the United States to scrap the island as a suitable site for testing. Thus the process of selecting Amchitka as an experimental test site shows how important certain (not all) environmental concerns could be to U.S. policymakers, even if they might not have used the explicitly environmentally conscious language that this dissertation does.

³³ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Testing, Windstorm, Memo from G. C. Marshall to Executive Secretary, National Security Council, Subj: Operation WINDSTORM, 21 May 1951

After the Amchitka discussion, the AEC and other policymakers settled into a pattern where the most important environmental issues surrounding testing, recognized as environmental in nature or not, were radiation from blasts and interactions with the weather. Radiation damage on the natural world was, for the most part, downplayed by those in power. In the early 1950s, the AEC noted that high air burst weapons tests showed that residual radiation was not a problem at ground level, but on blasts close to the ground significant radiation contamination existed. Of course, since such detonations destroyed everything for at least a 300-400 yard radius, residual radiation was something of a moot point.³⁴ Also, a March 1952 memo from the AEC to the White House claimed that upcoming tests might produce “some off-site radiation above normal levels, but far below levels harmful in any way to humans, animals or crops.”³⁵ Yet one of the more interesting interplays between atomic weapons and the environment involved decisions and considerations about meteorological phenomena.

In the early 1950s, both the AEC and White House paid significant attention to how weather influenced atomic bomb tests and how those tests might affect the weather. Before and after any nuclear blast, testers made significant meteorological measurements to ensure that proper conditions existed for those tests. After one test, an Air Force “group of 2,400 made weather observations, and operated experimental aircraft including radar-directed ‘drones’ to collect observations in and near the radioactive clouds that follow atomic explosions.”³⁶ In the aforementioned March 1952 memo, the AEC

³⁴ *Tenth Semiannual Report of the Atomic Energy Commission, July 1951*, 3.

³⁵ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Letter Morse Salisbury to Joseph Short, Subj: Draft Press Release on New Tests, 19 March 1952, 2. Morse was the Director of the Division of Information Services of the AEC and Short was the Press Secretary to the White House.

³⁶ *Tenth Semiannual Report of the Atomic Energy Commission, July 1951*, 6.

representative said that precautions for preventing excessive radiation included “cloud tracking and sampling” by the Air Force and cooperation with around 100 Weather Service stations.³⁷ These two pieces of data started to show the importance of weather to those testing atomic weapons, but do not fully show the true weight of meteorological effects on the process.

The January 1953 AEC report contained a great deal of focus on weather and atomic bomb tests. To begin, the report explained the precautions taken during weapons tests to prevent “hazard to the public from blast or fall-out.” To do this, the AEC constructed a national system to monitor “fall-out radioactivity.” One of the best ways both to prevent the spread of fallout as much as possible and gain accurate test results was to make sure that proper weather conditions existed before tests. Before each test, pre-detonation forecasts began 72 hours in advance. If those predictions were still favorable 24 hours before a scheduled test, the operational sequence began. If weather proved unfavorable, the test might be canceled. Since wind and rain were known to dramatically affect fallout distribution, the weather formed a crucial part of ensuring a test that was as safe as possible. The report also claimed that the “intensity of blast waves at any locality depends more upon various weather phenomena than upon the energy yield of the detonation.”³⁸ Simply put, the weather was not just a secondary concern

³⁷ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Letter Morse Salisbury to Joseph Short, Subj: Draft Press Release on New Tests, 19 March 1952, 3-4.

³⁸ *Thirteenth Semiannual Report of the Atomic Energy Commission, January 1953*, 77-97. And it is an important reminder that these atomic bomb tests fundamentally were about producing data for scientists to analyze. Take, for example, the massive data sets on subjects like subsurface temperature of the bomb range in Las Vegas, Nevada (June 1951) or seismological readings at Amchitka. See: NACP, RG 374 Records of the Defense Threat Reduction Agency, Box 6, Folder Original Field Notes, Proj 1(8)a, Opn B-J or NACP, RG 374 Records of the Defense Threat Reduction Agency, Box 6, Folder Records from the Seismic Survey of Amchitka Island. Reference Program 8.1 of Windstorm Operation. Classified Information.

when planning and conducting tests—it mattered a great deal to planners who wanted the tests to be as safe as possible and the data gathered from tests to be accurate.

For a time, significant concerns also existed about whether atomic detonations might have themselves on the weather.³⁹ The 26 May 1953 meeting of the AEC commissioners contained discussion on the subject. Gordon Dean, chairman of the AEC at the time, questioned whether adverse weather conditions following detonations at Eniwetok could be attributed to those tests, as a report had claimed the bad weather “appeared to have been caused by the shots.” Photographs showed that heavy clouds and squalls developed after the test shots, along with a series of high altitude storms (around 40,000 feet high). The committee eventually decided “weather conditions prior to the shot time were favorable to rain, and the large vertical disturbances caused by the blast seemed to have ‘triggered’ the storms which began at Eniwetok and spread north and west over an area of 250,000 square miles.” But they also commented that “meteorological experts” had not discerned “any relationship between the recent weather conditions throughout the U. S. and the Nevada tests.”⁴⁰ Even though experts had not decided on a link between tests and weather, many in the public had.

Several letters from civilians can show how many in the public connected atomic bomb tests and meteorological phenomena. One letter to Sherman Adams, Eisenhower’s White House Chief of Staff, talked about the author’s “very dear friend,” a 74 year-old farmer. That farmer’s crops were six weeks late and he believed, “as many others do, that the atomic bomb is responsible for it.” The farmer wanted the blasts “postponed for a

³⁹ Of course, the notion that human activities, especially explosions and detonations, might have an affect on the weather is nothing new. See: James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010)

⁴⁰ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 869, 26 May 1953, 325.

while so the nation wouldn't starve to death."⁴¹ Another man, in a letter to James C. Haggerty, Eisenhower's Press Secretary, claimed that tests needed to stop. This letter claimed that, "due to atmospheric changes due to the high explosives of the atomic weapons," there now existed problems "with the atmospheric conditions in our country resulting in tornadoes where they have either never previously occurred, or – where tornadoes have previously been experienced – now being of unusual intensity."⁴² While neither environmental science at the time or at present would support such assertions, the letters do demonstrate examples of public pressure exerted on White House policymakers over worries about a connection between the natural world and atomic bombs.

On 10 June 1953, the AEC commissioners again met to discuss the effects of nuclear tests on weather, particularly because of "numerous charges" in the press saying that tests at Nevada Proving Grounds had caused "unusual weather conditions in parts of the United States."⁴³ During previous tests at Eniwetok, weather conditions after tests had jibed with pre-test meteorological predictions. With the evidence presented, the Commissioners reckoned that the disturbances after several tests, which included "rain squalls over the ocean [and] small storms, but no winds of hurricane force," might have been caused by blasts. A military representative, along with an UCLA-based scientist, claimed that there had been similar air circulations following tests in Nevada as at the

⁴¹ The letter's author also asked if Eisenhower could send his farmer friend a letter, as Eisenhower was the first present in forty-five years to not respond to the farmer's letters. This would be "Just a gesture in the spirit of Democracy." DDEL, White House Central Files, General File, Box 1213, Folder 155 Atomic Energy, 1952-53, Letter Bertram G. Frazier to Sherman Adams, 2 June 1953.

⁴² DDEL, White House Central Files, General File, Box 1214, Folder 155-A, Atomic Bomb, Letter George R. Carr to James C. Haggerty, 9 June 1953

⁴³ Though this dissertation does not cite anything specifically, also see: *Fourteenth Semiannual Report of the Atomic Energy Commission, July 1953*, 53. One of the more intriguing resources for studying the 1,350 square mile (860,000 acres) Nevada Proving Grounds has to be *The Nevada Test Site*. As the book claims in its preface, "While the nuclear genie popped out of his bottle at White Sands Proving Ground on July 16, 1945, it may be said that he learned to dance at the Nevada Test Site." *The Nevada Test Site: A Guide to America's Nuclear Proving Ground* (Culver City: The Center for Land Use Interpretation, 1996), 7, 9.

Pacific Proving Grounds, but the continental tests only caused disturbances for a few minutes and lacked sufficient moisture in the desert to create storm conditions. They continued, “No material in the bomb debris could cause rain or a tornado. It was possible for a tornado to be ‘triggered’ by external conditions, but it needed moisture as a fuel to become selfsustaining [sic].” Instead, the unusual number of tornadoes that spring “could be attributed to an unusual pressure condition forcing moist Gulf air across the U. S. at high level until it came in contact with a cold air mass coming down from Canada, and that by no mechanism known was it possible for the tornadoes to have been caused by the Nevada tests.” In the end, the commissioners decided that they needed to respond to public views, especially the charges that tests at the Nevada Proving Grounds had caused tornadoes.⁴⁴ Scientific understandings about the relationship between bombs and weather may have assured the AEC Commissioners that nuclear weapons could not cause violent storms, but it did not convince everyone.

No matter the official position, public perceptions of atomic bomb tests causing severe weather proved so strong that Representative Edith Nourse Rogers (R-MA) introduced a series of resolutions requesting that the AEC provide information about the connection between nuclear tests and the weather. Senator William Langer (R-ND), in a related move, offered a resolution that proposed that no further atomic tests could be held in the continental United States.⁴⁵ The issue continued to be prominent for several years,

⁴⁴ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 875, 10 June 1953, 357.

⁴⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 877, 17 June 1953, 365-366.

as the AEC held a conference in 1956 on “Possible Effects of Nuclear Explosions on Weather.”⁴⁶

No matter the effects on weather, nuclear weapons tests perhaps became more important when Dwight Eisenhower assumed the presidency on 20 January 1953. As a staunch fiscal conservative, Eisenhower’s term showed him deeply committed to the responsible use of the nation’s financial resources. Of course, as the former leader of Allied forces during World War II, he also focused heavily on U.S. military commitments and issues of national security. To balance both financial and military considerations, Eisenhower devised a foreign policy plan called the “New Look.” This strategy sought to use strategic nuclear weapons in lieu of conventional military forces to deter the USSR and Soviet bloc countries from attacking the United States and its allies. In short, Eisenhower figured it to be cheaper to create a nuclear stockpile than to train, equip, feed, and supply a large standing army. Nuclear testing formed a crucial and necessary part of this “New Look” policy as improving and increasing the U.S. nuclear stockpile meant, under this logic, keeping the nation safe in the most cost efficient way.⁴⁷ With this strategy in mind, under Eisenhower the United States continued previous research into atomic weapons and developed bombs of previously unfathomable power.

The hydrogen bomb, a thermonuclear weapon that incorporated the fusion of atoms (not principally fission like previous atomic bombs), launched the world into the thermonuclear age and at the same time radically altered the scale of potential

⁴⁶ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 2, Folder Conference – Effect of Atomic Weapons on Weather

⁴⁷ Eisenhower did not commission the nation’s scientists to improve and mass produce atomic weapons merely for show, either. Michael Gordon Jackson has showed that Eisenhower likely was quite serious about possibly using nuclear weapons during the Korean War, much more willing than many had previously supposed. Michael Gordon Jackson, “Beyond Brinkmanship: Eisenhower, Nuclear War Fighting, and Korea, 1953-1968,” *Presidential Studies Quarterly*, Vol. 35, No. 1 (Mar., 2005), pp. 52-75.

environmental change from atomic weapons.⁴⁸ Lewis Strauss, Chairman of the AEC, elucidated on the thermonuclear tests at President Eisenhower's 31 March 1954 official press conference. Strauss had recently visited the Pacific Proving Grounds to view the second part of a series of tests of thermonuclear weapons. He explained that after the Soviets had detonated their first atomic bomb in August 1949, U.S. military higher-ups had decided that the United States could only maintain its nuclear superiority over the Soviet Union with either a significant quantitative edge in bombs or by developing something greater than existing fission weapons "by a degree of magnitude comparable to the difference between fission bombs and conventional bombs." Therefore in 1950 President Truman had asked the AEC to start making a hydrogen or fusion bomb—a thermonuclear bomb. The United States tested a prototype at Eniwetok in November 1952 and the Soviets tested one in August 1953. On 1 March 1954, however, as part of

⁴⁸ Alan Moore's graphic novel *Watchmen* contains a character with the ability to manipulate atoms at a molecular level, Dr. Manhattan, clearly meant to represent the terror produced by atomic bombs and especially thermonuclear weapons. Though a work of fiction, one particular quotation about Dr. Manhattan particularly explains the effects atomic bombs of ever-increasing power had on the world psyche:

"Manhattan's existence was announced to the world in the March of 1960, and I don't think there can have been anybody on the planet who didn't feel that same strange jumble of emotions when they heard the news. Foremost amongst this assortment of sensations was disbelief. The idea of a being who could walk through walls, move from one place to another without covering the intervening distance and re-arrange things completely with a single thought was flat-out impossible. On the other hand, the people presenting this news to us were our own government. The notion that they might simply have made it up was equally improbable, and in the face of this contradiction, it became gradually easier to accept the dream-like unreality of those first newsreel images: a blue man melting a tank with a wave of his hand; the fragments of a disassembled rifle floating there eerily in the air with nobody touching them. Once accepted as reality, however, such things became no easier to digest. If you accept that floating rifle parts are real you also have to somehow accept that everything you've ever known to be a fact is probably untrue. That peculiar unease is something that most of us have learned to live with over the years, but it's still there.

"The other emotions that accompanied the announcement were perhaps harder to identify and pin down. There was a certain elation...it felt as if Santa Claus had suddenly turned out to be real after all. Coupled with and complementary to this was a terrible and uneven sense of fear and uncertainty. While this was hard to define precisely, if I had to boil it down into three words, those words would be, 'We've been replaced.' I'm not just talking about the non-powered costumed hero fraternity here, you understand, although Dr. Manhattans appearance was certainly one of the factors that led to my own increased feelings of obsolescence and my eventual decision to quit the hero business altogether. You see, while masked vigilantes had certainly been made obsolete, so in a sense had every other living organism upon the planet. I don't think that society has fully realized yet just exactly what Dr. Manhattan's arrival means; how much it's likely to change every detail of our lives." Alan Moore and Dave Gibbons, *Watchmen* (New York: DC Comics, 1986, 2005), 13.

Operation Castle, the United States tested what was easily the biggest nuclear device the world had seen to that time.⁴⁹

That 1 March shot, codenamed “Bravo,” ended up being several times more destructive than expected and produced significantly more fallout than anticipated. Strauss stressed that the test did not get out of control, and even when badgered by the media about whether other tests might, he responded, “I am informed by the scientists that [a test getting out of control] is impossible.”⁵⁰ Further emphasizing that the test had not been out of control as suggested, Strauss argued that the AEC “has conducted the tests of its larger weapons away from the mainland so that the fall-out would occur in the ocean where it would be quickly dissipated both by dilution and by the rapid decay of most of the radioactivity which is of short duration.” This is why the United States conducted previous tests at Bikini in the Marshall Islands—it has good winds from February to April that would blow any fallout away from inhabited atolls. The biggest problem with the Castle Bravo test, however, was that it far exceeded any estimates of its power and did indeed smother with fallout both Marshall Island inhabitants and a passing Japanese fishing vessel, the *Lucky Dragon 5* (called the “Fortunate Dragon” by Strauss).⁵¹

Strauss defended U.S. actions and downplayed any problems, environmental or otherwise, with the Bravo test. He explained that the public and press had the wrong idea about what these Pacific atolls were like. He said, “Each of these atolls is a large necklace

⁴⁹ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 2, Folder Press Conference 31 March 1954, Statement by Lewis L. Strauss, 1. Also see: *Seventeenth Semiannual Report of the Atomic Energy Commission, January 1955*, 14.

⁵⁰ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 2, Folder Press Conference 31 March 1954, Official White House Transcript of President Eisenhower’s Press and Radio Conference #33, 13.

⁵¹ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 2, Folder Press Conference 31 March 1954, Statement by Lewis L. Strauss, 2-3.

of coral reef surrounding a lagoon two to three hundreds of square miles in area, and at various points on the reef like beads on a string appear a multitude of little islands, some a few score acres in extent-others no more than sandpits,” and the U.S. used the “small, uninhabited, treeless sand bars” for experiments. He further explained, “The impression that an entire atoll or even large islands have been destroyed in these tests is erroneous. It would be more accurate to say a large sandspit or reef.”⁵²

With his statement, Strauss also noted several other environmental phenomena worth mentioning. First, he again reinforced the importance of meteorology to tests when he discussed how, before each test shot, testers carefully surveyed the winds at all elevations up to many thousands of feet (because winds are not the same at every elevation). He also explained that testers conducted long-range weather forecasts because it takes days to do these measurements. Strauss also reluctantly admitted that, even though there was a warning area set before tests, sometimes humans did get caught in the danger zone of fallout, including the crew of the *Lucky Dragon*, the “natives,” and some weather personnel. And though the tests caused some increase in “background” radiation, this decreased rapidly and the stories about widespread contamination of tuna or other fish could not be substantiated. Instead, the only place anyone had found contaminated fish was in the hold of the *Lucky Dragon* and, of course, those near the test site. These fish near the test site, though, should not have concerned anyone, according to Strauss, because “at certain seasons of the year, almost all fish caught are normally poisonous as a result of feeding on certain seasonally prevalent micro-organisms, and the natives and our

⁵² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 2, Folder Press Conference 31 March 1954, Statement by Lewis L. Strauss, 2.

Task Force personnel do not eat them at such times.”⁵³ This statement shows Strauss believed that since the only fish contaminated by radiation were not fit for human consumption anyway, they were presumably worthless by any measurement. No matter the negative consequences from the 1954 hydrogen bomb tests, the United States continued to test in the Pacific.

In late 1954, the Department of Defense and AEC began to plan a deep underwater nuclear test to be held between 15 April and 15 May 1955, somewhere 200-600 miles south/southwest of San Diego, California. Robert Anderson, Secretary of Defense, told Eisenhower in a letter that the military intended to determine “the maximum range at which hull-splitting damage to a submerged submarine at a single depth can be assured.” The exact area in which the test would be conducted would “be determined more closely upon completion of special oceanographic studies now being carried out by the Scripps Institute of Oceanography and the Office of Naval Research.” Either way, the general area was “essentially free of fish which are of commercial importance,” so the idea was that no matter where they test occurred in the area it would not affect the fishing industry (not necessarily true, especially considering tuna’s ecological role as a top predator and thus their ability to bioaccumulate toxins). Also, officials assured Eisenhower the ocean current and wind patterns in the area would reduce “the possibilities of contamination due to migration of fission products through ocean or air currents.” Anderson tried to allay any worries about the spray of radioactive water over great distances, such as happened during the Crossroads Baker test, by assuring that conducting the test at a depth of around 2,000 feet meant that there would

⁵³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 2, Folder Press Conference 31 March 1954, Statement by Lewis L. Strauss, 2-4.

be no significant water upheaval or wave formation. One problem, though, was that Mexican nationals would have to be evacuated from Guadalupe Island, about seventy-five miles away from the intended test area.⁵⁴ As in previous tests, understandings of the natural world and earth systems proved essential both in planning for tests and for allaying concerns about the tests' potential harmful effects. Those understandings did not necessarily mean a desire to protect the landscapes and the creatures that inhabited these, however—Guadalupe Island, for example, was known for its endemic species and as one of the last safe havens for certain seals. Such statements might seem paradoxical, but would not have been so to AEC policymakers because, to them, not all environmental concerns were equally important in their charge to develop a nuclear arsenal that would presumably protect the United States.

On 15 March 1955, the AEC Commissioners met to discuss the upcoming underwater test, named Operation Wigwam, and showed clear thinking about environmental scientific understandings in their decisions. The AEC finalized the shot as a thirty-kiloton bomb detonated at a depth of 2,000 feet. Before anything else, the Commissioners first discussed the geography of the test area and reviewed the conclusions of studies on the seismic effects, ocean surface effects, and the airborne, waterborne, and organic contamination that could be expected to result from the test. And even though nobody could predict exactly what would happen with the underwater detonation, somehow the Commissioners were “certain that none of the effects of the test will constitute a threat to health or safety.” Importantly, Navy studies showed that the test site was “a marine desert avoided by fish and fishermen in which the ocean current drifts

⁵⁴ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1954-54 (2), Letter R. B. Anderson to Eisenhower, 8 December 1954

south and the prevailing wind is from the north.” In short, the natural features of the area made the location ideal for an underwater atomic bomb detonation, and Strauss made a clear connection between oceanic and terrestrial deserts—both environments served little purpose to humans unless used as a partition to sequester bombs’ destructiveness from other, useful environments. The AEC then decided that the test would happen on 8 May 1955, pending proper weather and ocean conditions.⁵⁵ The actual test occurred about a week after that. The July 1955 semiannual AEC report declared, “the test involved no health hazard to mainland or island inhabitants or consumers of fish.”⁵⁶

In general, after 1954, the issue of fallout and the radiation effects of weapons tests became more important, but not necessarily because of concerns about environmental health. In part, this is because the public began to be much more concerned about radioactive fallout, particularly after the *Lucky Dragon* incident. AEC Commissioner Lewis Strauss sent a letter to President Eisenhower in March 1955 about an upcoming test that would be conducted around 40,000 feet high. Strauss included an article titled, “Atomic Blast Six Miles Up To Test New Air Defense: Nuclear Warhead For Missiles Use To Be Tried Out Soon In Nevada.” Strauss thought the article was important because it would “prevent apprehension by observers of the high altitude test (40,000 feet) which will be seen for long distances.” The piece told its readers that even humans standing at ground level directly underneath the blast would only receive 1/100th

⁵⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 8, Meeting No. 1067, 15 March 1955, 166-167.

⁵⁶ *Eighteenth Semiannual Report of the Atomic Energy Commission, July 1955*, 32.

of a normal x-ray dose because the test would be so high up.⁵⁷ No matter the assurances many civilians still felt nervous.

In spring 1956, a reporter questioned the President about why the United States continued to research the hydrogen bomb, prompting Eisenhower to discuss the interconnectedness of environmental science and atomic weapons research. The President responded that the nation went ahead with testing “not to make a bigger ‘bang,’ not to cause more destruction, [but instead] to find out ways and means in which you can limit it, make it useful in the defensive purposes of shooting against a fleet of airplanes coming over, to reduce ‘fall-out,’ to make it more a military weapon and less one just of mass destruction.” He closed by saying that the country knew how to make atomic bombs big, but that did not interest the United States anymore—making smaller bombs of reduced fallout did.⁵⁸ Reducing fallout required improving scientific knowledge in both environmental sciences and physics, meaning that military requirements forged a stronger bond between scientific knowledge about these and weapons testing.

The argument that the U.S. needed to test so that it could reduce fallout was common. The July 1956 semiannual AEC report discussed Operation Redwing that had occurred a few months prior. Redwing was a full-scale test series at Eniwetok aimed “toward development of defensive weapons.” The AEC planned such tests for earlier than they occurred, but had postponed these due to unfavorable weather in the interest of safety, especially after the 1954 Operation Castle Bravo shot. Monitoring the weather,

⁵⁷ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (7), Letter from Lewis L. Strauss to Eisenhower, 28 March 1955

⁵⁸ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 4, Press Conference 25 April 1956, Official White House Transcript of President Eisenhower’s Press and Radio Conference #85, 8.

then, functioned as a safety precaution not only for the shot itself, but also for control of the resulting fallout. Other tests also had programs “to make measurement of radioactivity in sea water and in marine organisms is being conducted in the Pacific.” Testers sampled the surface water and at various depths, and also plankton and fish, with sampling extending “as far westward as radioactivity is detectable.” Radioactivity sampling also occurred as land and marine biological surveys on Eniwetok and Bikini Atolls and lagoons.⁵⁹

No matter the studies or assurances, though, many in the public remained wary of the fallout threat from radioactive fallout. One letter to the President about harm to fishing industries from hydrogen bomb tests received a response quoting a statement by Lewis Strauss that claimed, “Our inspectors found no instance of radioactivity in any shipments of fish from Pacific waters.”⁶⁰ Another letter asked the President to stop hydrogen bomb tests because these created strontium 90 that eventually made its way into the U.S. milk supply. The White House Chief of Staff, Sherman Adams, responded to this letter by assuring that the United States would keep testing and developing weapons because these would keep the nation safe in the long run.⁶¹ And a R. M. Tildesley caustically suggested that the President use the Nevada Proving Grounds as a vacation spot, arguing, “By setting out to make the biggest possible bomb to kill the most

⁵⁹ *Twentieth Semiannual Report of the Atomic Energy Commission, July 1956*, 8, 115. Also see: *Twenty-First Semiannual Report of the Atomic Energy Commission, January 1957*, 9-11.

⁶⁰ DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Sept. to date 1956 (1), Letter Dorothy Leslie to the President, 21 October 1956 and Letter Howard Pyle to Dorothy Leslie, 30 October 1956

⁶¹ DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Sept. to date 1956 (1), Letter Mrs. Mitchell Fine to President, 26 October 1956 and Letter Sherman Adams to Mrs. Mitchell Fine, 31 October 1956 This letter from Lewis Strauss to President Eisenhower also stressed the need for testing to improve weapons for the “defense stockpile” and reducing fallout or radiation “contamination which might result from the spread of nuclear material from weapons involved in fire or accident.” DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (1), Letter Lewis Strauss to Eisenhower, 21 December 1956

possible people, we seem to have scared the pants off ourselves. Now we are hoping for the age of the clean bomb.”⁶²

A public statement by the President in October 1956 furthered the U.S. government’s public position that the nation’s citizenry should not worry about nuclear fallout from tests. Eisenhower reminded the public that fallout had been a known issue since the very first atomic test at Trinity, and that the AEC had been “continuously engaged in the study of the biological effect of radiation.” Reports on the subject were publicly available, and a 1956 findings of the National Academy of Sciences called biological damage from tests “essentially negligible.” Moreover, The National Academy of Sciences’ Committee on Meteorology determined “there was no evidence to indicate that climate has been in any way altered by past atomic and thermonuclear explosions.”⁶³

One series of tests, Operation Plumbbob, can serve as a final example of how significant focus on the interaction between environmental science and nuclear detonations had emerged by the end of the Eisenhower presidency. Operation Plumbbob’s primary purpose was to increase scientific knowledge about nuclear tests, especially concerning fallout and the biomedical effects of tests. Thus while the tests did not focus exclusively on improving knowledge on nuclear testing and the environment, a great many sub-projects did have such a concentration. The project proposal claimed that the Plumbbob shots would “contribute significantly to the knowledge necessary for the improvement of our self-defense against enemy action in the event of war and the

⁶² DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Jan. – Aug. 1957 (2), Letter R.M. Tildesley to President, 29 June 1957 For other examples, see: DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Jan. – Aug. 1957 (2), Petition from University of Washington students, 24 June 1957 and DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Jan. – Aug. 1957 (2), Letter R.M. Tildesley to President, 29 June 1957

⁶³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956

establishment of proper safeguards in peacetime applications of nuclear energy.” The test series included projects, among many others, on “Radio-Ecological Aspects of Nuclear Fallout,” intended to study “persistence of gross fission products” in the environment after fallout; “Biophysical Aspects of Fallout Phenomenology,” which studied “the physical and chemical characteristics of fallout materials”; and an inquiry into “the physical and chemical characteristics of fallout materials,” which made “fallout studies on raw agricultural products, such as exposed wheat dumps, corn and sugar cane stalks, and dried-fruit flats, to determine whether cleanup is possible, to recommend methods of protection, and to evaluate types of agricultural packaging.”⁶⁴

As in earlier tests, Plumbbob also showed a concern for how the test site environment might affect and be affected by a nuclear detonation. The 17 April 1957 AEC Commissioners meeting included discussion of a “Special Shot” for Plumbbob that would be underground. This test presented two major problems—containment of the radiation and accurate measurement of the yield. Moreover, the Nevada Test Site had geological conditions that would help ensure that the test shot did not cause an earthquake. Fears existed that if an earthquake did happen at the same time that the AEC might be blamed for the natural occurrence, but if an earthquake did take place seismic readings could tell from where it originated. The Commissioners also discussed what would the likely effects of an underground firing be, and “the extent of absorption of

⁶⁴ Other projects also had a distinctly environmental or biological component. DDEL, John Stewart Bragdon Records, Miscellaneous File, Box 1, Folder Atomic Energy Commission, Operation Plumbbob Civil Effects Test Group Project Summaries, 1957, ii, 42, 43, 47.

energy at a given geologic fault.” They reached the conclusion that very little energy could be transferred “through a fault from one structure to another.”⁶⁵

When that underground test shot eventually occurred, it seemed to be a resounding success and demonstrated that policymakers had explicitly incorporated natural features into their tests. The Ranier Shot of Operation Plumbbob, fired on 19 September 1957, was a 1.7-kiloton test blast in a tunnel in a mesa at the Nevada Test Site. Intended to “eliminate fall-out, be independent of weather, and eliminate other offsite effects,” evaluators declared after the test, “practically all radioactive fission products were trapped in highly insoluble fused silica, indicating very little likelihood of ground water contamination.” Thus even though three months later the test site still had elevated temperatures from the radiation (up to 194 degrees Fahrenheit), those testing thought the shot went so well “that devices 100 times as powerful as Ranier could be safely fired underground at the Site.”⁶⁶ No matter the lasting radiation, the environment was not only the setting for the Ranier Shot, but also incorporated as a crucial element in planning the shot.

Once the dust settled on Plumbbob, the AEC had detonated twenty four nuclear devices and conducted six “safety experiments” on reducing fallout in the natural world at the Nevada Test Site, from 15 March to 12 October 1957. Two new testing techniques proved important—suspending bombs from balloons and detonating bombs deep underground. Using balloons prevented the atomic bomb’s resulting fireball from touching the ground and this supposedly dramatically lowered the amount of radioactive fallout. The January 1958 semiannual AEC report claimed that of the tests that used this

⁶⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 10, Meeting No. 1277, 17 April 1957, 193-195.

⁶⁶ *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 14.

method, “none resulted in significant fallout in the test region.” The report described how, for the underground tests, “a tunnel was dug horizontally into a mesa and at its end was bent in almost a complete circle.” The testers placed a “device of known low yield” at the end of the tunnel, as this formation would seal off the main tunnel with rocks during the detonation so that no radiation might escape. The AEC declared, “The experiment’s objective of containing all radiation was achieved.”⁶⁷ Preventing fallout had been a major area of the Plumbbob tests, and when combined with the attention paid to how the shots interacted with the natural world it is clear that the environment had come to play an integral role in how the United States and the AEC conceived of atomic bomb tests and their effects. The underground tests can also help emphasize another seeming paradox in U.S. nuclear testing and the environment—while one of the greatest benefits of underground nuclear tests was that these produced little to no atmospheric radioactive contamination or fallout, the stated purpose of such tests often was to improve environmental scientific knowledge. Policymakers in the AEC clearly privileged certain understandings of the natural world more than others, especially depending on how these did or did not support what the AEC perceived to be its mission and purpose within the U.S. government (environmental protection certainly was not).

Despite a lawsuit trying to end nuclear testing, a hunger strike by citizen activists at the AEC headquarters, and one man claiming that nuclear testing during a full moon might cause flooding, the United States government continued to have few public reservations about its own tests.⁶⁸ The AEC claimed that weapons testing had the major

⁶⁷ *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 274-275.

⁶⁸ The “Suit to Enjoin Nuclear Tests,” filed by a group of fourteen people from five different countries, used specifically environmental reasoning. It asked “to enjoin the Atomic Energy Commissioners and the Secretary of Defense from detonating any nuclear weapons that produce radiation, and specifically the tests

objectives of “improved weapons; smaller, more efficient, and more rugged strategic, tactical and defensive weapons; development of strategic, tactical and defensive weapons with greatly reduced radioactive fallout.”⁶⁹ The implication with such a statement is clear: nuclear testing had only gotten safer and produced less fallout so the public should not worry about it. But nonetheless, when asked about seeing an actual atomic bomb test, President Eisenhower replied at one press conference, “They won’t allow me.” After the laughter died down, he elaborated, “I have seen all the weapons, I just haven’t been allowed to go to the tests.”⁷⁰ The bombs may have been safe hypothetically or in public statements, but were not safe enough when the President’s wellbeing was on the line. Of course, the tests never were entirely safe, even with precautions. After one test series, Operation Hardtack, one memo stated, “the land area of the Bikini and Eniwetok Atolls, the water area of their lagoons, and the adjacent areas within three miles to seaward of the atolls and the overlying airspace will remain closed to vessels and aircraft which do

scheduled this month at Eniwetok. The plaintiffs claim that these tests will produce radioactive fallout which will produce harmful mutations in their progeny and will probably give them leukemia and bone cancer. The four Japanese also claim that they are fishermen who will be barred from the Eniwetok area.” DDEL, White House Central Files, Official File, Box 451, Folder OF 108-A Atomic Weapons, Atomic and Hydrogen Bombs (9), Letter from George Cochran Doub to H. Roemer McPhee, 23 April 1958. The hunger strike at AEC headquarters occurred in May 1958. NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 11, Meeting No. 1372, 9 May 1958. And the citizen worried about the moon, James H. Ouzts, was quite serious, even though it appears comical now, when he claimed, “Urgently request that under no circumstances you permit any type of hydrogen or atomic war head be exploded any where near the moon most especially when it is new because the margin of balance between the Earth and moon at this time is so small and the attraction between them is so great that it will move billions of gallons of water on Earth and cause flood tides. If this balance should be interrupted and cause the dark side of the moon to swing toward Earth then you have a situation the same as a positive atom and a negative electron. In the name of God and humanity I urgently request that you pass this information to the rest of the world.” DDEL, White House Central Files, General File, Box 1216, Folder 155-B, Apr. – June 1959, Telegram James H. Ouzts to President, 23 March 1959.

⁶⁹ *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 13.

⁷⁰ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 8, Press Conference 17 June 1959, Official White House Transcript of President Eisenhower’s Press and Radio Conference, #161, 4-5.

not have specific clearance.”⁷¹ The craft that did have clearance likely focused on conducting surveys “to measure radioactivity in sea water and marine organisms.”⁷² Tests produced significant worldwide radioactive fallout, and this increased as more nations detonated more bombs over time, leading to concern at the highest governmental levels for the environmental problems of testing.

On 31 October 1958, the United States, United Kingdom, and Soviet Union entered into nuclear test cessation talks in an attempt to achieve a full ban of all nuclear weapons tests by signing nations (the focus of Chapter Three). This marked a pivotal moment in nuclear testing for the entire world, but it must be noted that the talks began only after the United States finished its Hardtack test series. Initially planned to end in July 1958, the actual series did not end until much later due to weather concerns—safety concerns hinged on weather conditions, further emphasizing the natural world’s effects on human plans.⁷³ At that point, U.S. tests ceased for a time as part of an agreement to work toward a treaty ban (even though these early talks would eventually not produce a signed treaty and the United States would again start testing during the Kennedy administration). But before tests stopped on that Halloween day, scientific knowledge about the environment thus weighed heavily on the minds of policymakers when it came to U.S. nuclear testing during the Truman and Eisenhower presidencies, so much so that decision makers frequently labeled individual test shots and sometimes entire test series

⁷¹ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 5, Folder Nuclear Energy Matters (5) [Apr-Oct 1958], Pacific Nuclear Tests Concluded, 3 September 1958

⁷² The pre-test estimations claimed, “the detonations are not expected to add enough radioactive material to natural levels of radioactivity in the ocean to be harmful to marine life.” Either way, testing of the waters and marine life occurred, as well as studies into the “ultimate destination and behavior of radioactivity in the sea water and in marine organisms.” *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 348-350.

⁷³ Robert A. Divine, “Eisenhower, Dulles, and the Nuclear Test Ban Issue: Memorandum of a White House Conference, 24 March 1958.” *Diplomatic History*, Vol. 2, Iss. 1 (October 1978), 327.

with names that evoked environmental imagery.⁷⁴ Recognizing this inculcation is important, even if the actions of U.S. policymakers did not reflect a desire to prevent the environmental destruction caused by the tests they approved.

Whether it was concern for how the weather might affect a test (or be affected by a test) or for the otters and geology of Amchitka Island, decision makers showed time and again that scientific conceptions of the natural world mattered in their decision-making processes.⁷⁵ Of course, this is not to say that consideration meant environmentalist sentiment—far from it. For example, policymakers saw little paradox in dismissing concern for Amchitka’s otters while at the same time cancelling the test series because other environmental features—geological elements—did not fit their testing requirements. Thus, no matter the frequent lack of concern for environmental welfare, the actions and decisions of policymakers reflect that they proved deeply conscious of the ramifications of their choices on the environment and how those spaces and their inhabitants might change plans for nuclear testing. Moreover, as time passed, the tests helped policymakers in both the White House and AEC develop an increasing awareness about the natural world, especially in relation to bomb tests. Simply put, the environment and environmental science mattered in U.S. nuclear tests and those in power understood a connection between nuclear weapons testing and the environment, and they worked these scientific understandings into decisions and policies. It is past time that we recognize that the nexus of nuclear weapons and the natural world operated as a two-way street, with

⁷⁴ Perhaps the best example of this is the Hardtack I test series from 28 April to 18 April 1958. The names of its individual test shots, in order of testing date, were: Yucca, Cactus, Fir, Butternut, Koa, Wahoo, Holly, Nutmeg, Yellowwood, Magnolia, Tobacco, Sycamore, Rose, Umbrella, Maple, Aspen, Walnut, Linden, Redwood, Elder, Oak, Hickory, Sequoia, Cedar, Dogwood, Poplar, Scaevola, Pisonia, Juniper, Olive, Pine, Teak, Quince, Orange, Fig.

⁷⁵ And even when the environment was not directly influencing decisions, it still surely remained on the minds of decision makers enough that they

scientific environmental knowledge affecting atomic tests just as much or more as tests altered the natural world.

Chapter Two

Fallout over Fallout:

De Facto Experiments on Radiation, the Environment, and Human Health

The 1951 Office of Civil Defense film *Duck and Cover* has been analyzed time and again by scholars for what it says about 1950s nuclear culture in the United States. The film shows an incredibly alert turtle—Bert—who always has his shell to keep him safe, along with a helmet and dapper bow tie. The film compared an atomic bomb blast to other dangers civilians dealt with and understood, like fires and automobile accidents. Then, with Bert as an example, the short film told school children if a nuclear attack occurred they should duck under their desk and cover up to avoid the dangerous nuclear blast, flash and any resulting broken glass. Toward the end of the film, the narrator proclaimed, “Duck and cover! That’s the first thing to do—duck and cover. The next important thing to do after that is to stay covered until the danger is over.”¹

However, one problem with nuclear bombs, distinguishing these from conventional explosives, is that nuclear bombs produce countless radioactive particles that can have effects long after the actual explosion—radioactive fallout. These radioactive fallout pieces are never very big individually and frequently looked more like dust than anything. And yet as humans came to know, this dust could be deadly and affect much larger areas than the initial bomb blast ever could. Over a long time period of time fallout can even spread out to cover the entire earth. While fallout cannot tear down buildings or destroy harbored ships, its effects on biological entities can be harsh, including skin burns, cancers, and in severe cases death. Thus *Duck and Cover* was not entirely truthful with school children when the film told them they should stay covered

¹ “Duck and Cover,” Directed by Anthony Rizzo (1952; Archer Productions) The just over nine minute film can be viewed in its entirety here: <http://www.youtube.com/watch?v=IKqXu-5jw60> Accessed 17 April 2012 For a comic strip starring Bert and covering the same material, see Figures 11 and 12.

until the danger ended, as radioactive fallout could cause problems for years after any atomic blast.

The United States and its policymakers learned about the perils of radioactive fallout from the world's very first atomic detonation at Trinity, but this does not mean that those men paid a terrible amount of care to the subject.² The first fallout studies began “with a reconnaissance survey of soil, animals and vegetation,” initially limited to areas near detonation sites. The AEC used planes to trace any wind drift of radioactive clouds formed after tests until that radioactivity dispersed.³ However, as Bert the Turtle's cinematic debut in 1951 shows, the Truman administration did not have nearly as sophisticated an understanding of fallout as later peoples would come to possess.

This chapter delves into how the Atomic Energy Commission (AEC) and executive branch learned about and dealt with fallout during the early Cold War, both in their testing plans and the public relations arena. Fallout played a much bigger role in decision making about the nuclear complex during Eisenhower's presidency than it did during Truman's. This happened in large part because seminal events during Eisenhower's term forced policymakers to incorporate scientific knowledge about radioactive fallout and the environment much more carefully into their plans and deliberations than they had before. Mostly because nothing prompted them to, Truman-era administrators proved much less sensitive to the ecological and health dangers posed by fallout. However, two nuclear weapon tests during the Eisenhower's first term—the

² President Eisenhower reminded the nation in 1956 that the U.S. government knew about radiation since Trinity. ² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956

³ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 14, Folder Fallout – Atmospheric Radioactivity, George T. Anton, “Program of the United States Government in Atmospheric Radioactivity,” 7 November 1960, 1.

1953 “Harry” test shot during Operation Upshot-Knothole and the 1954 “Bravo” test shot during Operation Castle—particularly awakened U.S. decision makers to the frightening possibilities of nuclear fallout. During Eisenhower’s presidency, nuclear fallout thus became much more important to policymakers and concern over fallout, as Chapter Three will show, even helped birth nuclear test cessation treaty talks. Worries about radioactive fallout from nuclear tests also played an increasingly significant role in the development of the U.S. nuclear arsenal, as U.S. policymakers had to balance protecting the nation from fallout while still developing nuclear weapons to keep the country safe from foreign enemies.

Less obvious, but in some ways more important for understanding radioactive fallout’s effects on the United States and the nuclear complex, U.S. nuclear tests unintentionally coalesced into a massive, uncontrolled experiment on interactions between radiation, ecosystems, and human bodies. Directly injecting radiation into human bodies to test its effects proved impossible due to ethical and scientific concerns. Thus while U.S. scientists knew roughly the potential dangers of radioactive fallout, they had never conducted any specific experiments to determine its exact results. Even as the AEC espoused concerns over and reassurances about human health, the Commission’s nuclear tests put radiation into ecosystems and human bodies with no real idea of exactly what that radioactivity’s effects would be. This de facto experiment did not follow the scientific method and had no control group, but it still functioned very similarly to the radioisotope tracer studies that were at the same time birthing understandings of ecosystem ecology. As Chapter Four will explain with a focus on agriculture, radioisotope tracers allowed researchers to trace the flow of elements through biological

processes and opened up incredible new opportunities for research about the natural world. Thus at the same time U.S. testers worked extremely hard to be precise with their scientific experiments about nuclear weapons, they inadvertently conducted an experiment that was at times just as dangerous as those bombs, but had no formal oversight. Spewing massive amounts of radiation into the atmosphere, in effect, acted as an investigation into the effects of radioactive fallout on human health through environmental contact.

While common people and the U.S. government may have known about fallout radiation much earlier, many of the most important historical works on the subject did not appear until the 1980s. Ralph Lutts argued that Rachel Carson's seminal environmentalist work *Silent Spring* made sense to peoples of the 1960s because talk about radiation from 1950s nuclear fallout had conditioned them to fear forces that could not be seen or sensed but still have incredibly deleterious effects.⁴ Richard Miller, in *Under the Cloud*, reminded readers that everyone, no matter where they lived, faced dangers from nuclear testing. He argued, "the shadow of the atomic cloud was shared by not only [peoples and places close to tests], but by *most* cities and towns across the country. Like the soldiers maneuvering in the desert, every person alive during the 1950s and 1960s lived under the atomic cloud."⁵ Some of the best works on the subject of fallout have probed the cultural dimensions of that phenomenon, such as Paul Boyer's *Fallout* and Robert Jacobs' *The Dragon's Tail*.⁶ Others have varyingly argued that the U.S. government either betrayed

⁴ Ralph H. Lutts, "Chemical Fallout: Rachel Carson's *Silent Spring*, Radioactive Fallout, and the Environmental Movement," *Environmental Review: ER*, Vol. 9, No. 3 (Autumn 1985), 210-225.

⁵ Richard L. Miller, *Under the Cloud: The Decades of Nuclear Testing* (New York: The Free Press, 1986), 8-9.

⁶ In *Fallout*, Boyer explored the "intense and continuing impact on American consciousness and culture" of the Cold War and the nuclear arms race and all the unintended consequences of those (especially nuclear testing). Or, in other words, he probed "the political, social, psychological, and cultural fallout of the

its people and harmed them with tests or that it held an exemplary safety record and did the absolute best it could.⁷ What is clear, however, is that not enough work has been done on understanding how policymakers understood, or did not understand, the connections between fallout, environmental science, and human bodies. While scholars have understood that decisions about nuclear weapons testing and policy have could affect the natural world and human bodies, there has yet to be an historical analysis of how environmental science affected executive policymaking. Governmental knowledge and policy about fallout developed and evolved over time particularly in relationship to the Upshot-Knothole Harry shot and the Operation Castle Bravo shot. Perhaps even more important to that knowledge and policy development, however was the massive, uncontrolled scientific experimentation on the planet's environments and peoples through nuclear fallout.

While planners showed concern about local radioactivity and its effects on the environs even from early nuclear blasts, it was not a great deal of concern. The AEC did fund research into the breeding records of cattle exposed to radiation by the first atomic

atomic bomb from August 1945 to the mid-1990s.” Paul Boyer, *Fallout: A Historian Reflects on America's Half-Century Encounter with Nuclear Weapons* (Columbus: Ohio State University Press, 1998), xii, xiv. Jacobs' work “is about stories, nuclear stories. Stories of how Americans came to understand nuclear weapons and what they imagined a nuclear war would be like. Stories that the U.S. government told to its own citizens and soldiers, and stories told in movie theaters and on the radio.” Robert A. Jacobs, *The Dragon's Tail: American's Face the Atomic Age* (Amherst and Boston: University of Massachusetts Press, 2010), 2.

⁷ On the harm done to U.S. citizens by fallout from nuclear tests, see Philip Fradkin's case study of the downwinders in Utah and Operation Upshot-Knothole, discussed later in this chapter. Philip L. Fradkin, *Fallout: An American Nuclear Tragedy* (Tucson: The University of Arizona Press, 1989) For a counter perspective, Barton Hacker argued, “Those responsible for radiation safety in nuclear weapons testing under the auspices of the Atomic Energy Commission were competent, diligent, and cautious. They understood the hazards and took every precaution within their power to avoid injuring either test participants or bystanders. Testing, of course, meant taking risks, and safety could never be the highest priority. Those in charge sometimes made mistakes, but for the most part they managed to ensure that neither test participants nor bystanders suffered any apparent damage from fallout.” Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947-1974* (Berkeley: University of California Press, 1994), 9.

bomb, Trinity, in July 1945. Policymakers further acted on this concern for how radiation affects domesticated animals by funding “surveys” in 1948 around tests at Bikini Atoll and in New Mexico. The medical scientists and biologists conducting those assessments focused on “the immediate victims in the plant and animal kingdoms” and determining which species were “highly vulnerable” or “more resistant” to radiation, particularly as part of the fascination with the effects of nuclear weapons as still newfound sources of scientific wonder. And yet, for all the concern about damages, the official AEC report to Congress on the last six months of 1948 downplayed the dangers of radiation. That report claimed, “Just as interesting as these immediate and striking effects, however, [...] Data already available indicate that there are no appreciable hazards of external radiation for men or livestock at the New Mexico bomb site outside of the fenced area of several hundred acres surrounding the actual place of explosion.”⁸ Later inspections would challenge those conclusions, but at that time fallout did not represent a particular concern for those testing, even if they proved conscious of it. Moreover, those people thought they had radioactive fallout mostly under control and confined only to the predetermined bombsite. Future claims also stressed that blasts did not cause much long-term radiation damage and, by mentioning that the first radiation injury occurred in 1896 from an X-ray, made sure that readers knew radiation certainly existed outside of atomic bombs and was not a new, terrifying problem for the scientific community.⁹

Truman-era policymakers thus frequently worked hard to downplay any concerns about fallout radiation, at times even going so far as to eschew tracking radioactive

⁸ *Fifth Semiannual Report of the Atomic Energy Commission, January 1949*, 92-93.

⁹ *Sixth Semiannual Report of the Atomic Energy Commission, July 1949*, 54. The report also detailed the effects of an atomic bomb blast, such as at Hiroshima, by what happened in concentric circles around the detonation center.

clouds produced by nuclear testing for fear of causing public panic. For example, in June 1951 Herbert Scoville, Chief of the Armed Forces Special Weapons Project, counseled a civil defense aviation representative that aircraft would not be needed to track radioactive bomb clouds “in order to warn civil populations of possible radioactive hazards.”

Scoville claimed that, in the case of an air burst bomb, plane tracking would be “an unnecessary complication in the civil defense picture” both in the risk to which it would expose the crew and the panic its reports might create on the ground. In any detonation “where serious contamination might occur,” the letter claimed that fallout would be local and then go downwind.¹⁰

One of the first clues that fallout might be a more significant problem than previously believed came in 1951 from environmental sampling nearly three thousand miles away from any nuclear bomb tests the United States had ever conducted. In 1951, rain samples taken in the northeastern United States showed traces of fallout from tests in Nevada from earlier that same year. This meant that fallout did not stay locally contained as previously believed. It was one thing to dump radiation over a relatively unpopulated Nevada, but when that fallout appeared over highly populated areas on the East Coast it was another. After that revelation, fallout monitoring increased with a sampling network established at the Eniwetok proving ground later that year and a mobile, two-person monitoring station 200-500 miles from the Nevada testing site in 1952. In conjunction with the Weather Bureau (a working relationship that would continue to intensify), the AEC also set up over a hundred fixed monitoring stations.¹¹

¹⁰ NACP, RG 374 Records of the Defense Threat Reduction Agency, Box 1, Folder Civil Defense – 1951, Letter Herbert Scoville, Jr. to L. P. Sharples.

¹¹ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 14, Folder Fallout – Atmospheric Radioactivity, George

In general, most of the concerns about fallout during the Truman administration eschewed environmental understandings and focused heavily on the effects that radiation would have on human bodies, especially evident in Project Sunshine. Sunshine, a recurring research series, focused on fallout and how it affected human bodies. The earliest research tended to center on strontium 90 (Sr^{90})—the fallout product most likely to affect human health—and deposits of it in human bones after atomic tests.¹² This research frequently avoided studying the environment in favor of concentrating on human health, later research, especially during the Eisenhower era, looked more closely at how Sr^{90} entered the human body and especially considered the environmental connections involved. For radioactive fallout to enter human bones, it would first need to be ingested as part of the body's diet. Since Sr^{90} most closely resembled calcium (this is why it frequently ended up in human bones), the ways humans ingested calcium received close attention during Sunshine studies. AEC records on Sunshine show that by the beginning of the Eisenhower Presidency, researchers started to turn their attention to dairy products like milk and cheese, but also the natural products that make up milk cows' feed like clover and oats.¹³

Hence while focus on fallout had begun to increase by the time Eisenhower succeeded Truman as President of the United States, it had not ascended to anywhere near the heights it would reach within the next decade. Previously, there had been relatively few reasons for policymakers to fear fallout as an incredibly menacing force.

T. Anton, "Program of the United States Government in Atmospheric Radioactivity," 7 November 1960, 1-2.

¹² NACP, RG 326 Records of the Atomic Energy Commission, Entry 73 Division of Biology and Medicine: Records Relating to Fallout Studies, 1953-1964, Box 1, Folder Sunshine – Gabriel – General Files, 1951 thru 1953

¹³ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 5, various folders on Project Sunshine Bulletin

Finding fallout radiation in New England or Sr⁹⁰ in agricultural products troubled many people, both experts and civilians. But unlike the hazards that would confront the nation during Eisenhower's first two years in office, Truman never had to deal with any massive events that both endangered huge swaths of peoples and brought fallout to the direct attention of the nation's citizenry. The first of those powerfully destructive nuclear tests occurred when Eisenhower had held the office of President for less than half a year.

During the spring and early summer of 1953, the United States conducted a test series at the Nevada Test Site called "Upshot-Knothole" that created significant fallout problems and first began to heighten policymakers' sensitivity to fallout. The 19 May test shot in that series, named "Harry" (some would later call it "Dirty Harry"), produced some of the most dramatic fallout radiation the United States has ever seen. The 21 May meeting of the AEC Commissioners discussed the fallout from that shot and initially deemed that, because of precautions like advising townspeople downwind of the blast to remain indoors from 9am until noon, no person exceeded the maximum permissible thirteen-week dose of radiation. The radiation cloud moved from the Nevada Test Site toward the St. George, Utah area and eventually out to the Gulf of Mexico (where presumably it did not matter anymore).¹⁴ Though they did not know it at the time, the people downwind of the Harry test shot unwittingly became involved in the AEC's uncontrolled experiment into human health and the environment.

After erroneously assuring themselves that likely no persons had been seriously injured from the fallout, the Commissioners then moved to discuss the safeguards in place before all tests to minimize fallout contamination risks, showing they did

¹⁴ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 865, 21 May 1953, 309-310.

previously have some idea about the dangers of radioactive fallout. As Chapter One showed, weather proved particularly important in minimizing fallout, but the Commissioners pointed out that reducing local fallout risks did not always ensure the reduction of long-range fallout, and thus the two had to be balanced. Three weather conditions proved particularly important for shots at the Nevada Test Site, and testers tried never to detonate nuclear weapons when the winds 30,000-45,000 feet high blew in the direction of the St. George-Bunkersville area; “a vertical wind shear [was] present which would focus the blast on Las Vegas”; or if the immediate forecast called for rain. The Commissioners emphasized, “Weather forecasts, both long-range and local, are reviewed until half an hour before the shot and if, at any time, these criteria are not met, the shot is postponed.” And yet, even with such precautions an element of luck existed, as unpredicted local thunderstorms were always possible. Rain after a test could dump tremendous amounts of radiation in a localized area, and the Commissioners assured themselves that small towns could be evacuated, if needed, and citizens in larger towns could be advised to stay inside. Thus, while there were no firm, written guidelines for when testing could occur, the above rules always had been followed, meaning tests had been and should be safe.¹⁵

Despite assurances of safety, however, the AEC continued to have problems with the fallout from “Dirty Harry.” Some farmers claimed that the Upshot-Knothole test series caused livestock deaths and injuries to the survivors, allegations the AEC immediately investigated. One farmer alleged that some of his cattle died of radioactivity, but State of Nevada veterinarians determined the cause of death was malnutrition. Other

¹⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 865, 21 May 1953, 310-311.

nearby cattle died after drinking from a waterhole, with allegations that they had died from radioactive water, but “an analysis of the waterhole showed less than a maximum permissible concentration.” What the AEC could not explain away, though, was that some livestock showed radiation burns, and perhaps as much as ten percent of the nearby 10,000 sheep died sometime after from then undetermined causes. Some of the nearby farmers, therefore, wanted to get out of the area or have the AEC buy their livestock—one man even wanted the Commission to buy his mining site. Naturally, this caused the AEC to worry about public relations, as some people “in the vicinity of the Nevada Proving Ground no longer had faith in the AEC.” To counteract this, the AEC placed great importance on “choosing, for an objective presentation of the AEC ‘case’, men who would enjoy the full confidence of the public.”¹⁶

A week later, the AEC Commissioners again discussed fallout problems from Upshot-Knothole, but their discussions evinced a clear emphasis on the liability the Commission might suffer and not an understanding of the interconnectedness between the environment and human health. The Commissioners considered involving specialists from agricultural colleges to help investigate animal deaths as “a matter of urgency.” They also again discussed the sheep that had died near the proving grounds and confusingly reported their deaths “had not been caused by radiation; however, since the animals might have suffered some radiation injury it is possible that this was a contributing factor in their deaths.” An exhaustive investigation into their deaths needed

¹⁶ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 875, 10 June 1953, 356-357.

to be conducted, though, to determine exactly what did kill the ungulates.¹⁷ Issues still existed with the public, though, and with good reason.¹⁸ No matter how much the AEC asserted that peoples who had stayed inside were fine and that the Commission's atomic bombs did not cause animal deaths, the public did not always believe the Commission and with good reason.

Though it took until 1984 for a judge to render the final opinion in *Irene Allen vs. The United States (Allen et al. v. U.S. Government, 1979)*, a federal court eventually determined that fallout from nuclear tests caused cancer in some "downwinders," as the people downwind of the tests came to be called. Environmentalist-journalist Philip Fradkin wrote that those who suffered had been unusually patriotic and innocent, saying their biggest problem was, "They trusted. That was their downfall." For Fradkin, the most serious breach in the whole affair was that the U.S. government, including the AEC, did not do more to warn the public about fallout dangers and how to protect their bodies. He wrote, "At one end of the scale of injustice, this breach of faith could be viewed as an act of sustained stupidity, while at the other it resembled a perfidious act carried out by a government against its own people."¹⁹ On the other hand, unless the AEC Commissioners planned in advance to be deceitful during their meetings discussed above, it is at least possible that the AEC truly did not know the extent of the damage their tests might cause. Since there is indeed a difference between ignorance and stupidity, perhaps the AEC's actions represent neither stupidity nor treachery and should not be placed on a scale of

¹⁷ For more on the sheep, see: Barton C. Hacker, "'Hotter Than a \$2 Pistol': Fallout, Sheep, and the Atomic Energy Commission, 1953, 1986," in *The Atomic West*, Bruce Hevly and John M. Findlay, eds. (Seattle: University of Washington Press, 1998)

¹⁸ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 6, Meeting No. 877, 17 June 1953, 369-370.

¹⁹ Philip L. Fradkin, *Fallout: An American Nuclear Tragedy* (Tucson: The University of Arizona Press, 1989), 24.

injustice at all—it is possible the U.S. government simply did not know enough to protect its citizens.

Where the Harry shot of Operation Upshot-Knothole began to alert the United States public to the danger fallout radiation could have, the 1 March 1954 thermonuclear blast of Operation Castle’s Bravo shot on the Bikini Atoll, as Chapter One described, clued in the entire world to the possible dangers. That Bravo (Figure 12) shot was much larger than expected and spewed radioactive fallout over huge stretches of the Pacific Ocean. AEC Commissioner Lewis Strauss tried very hard to downplay any problems publicly, but a 12 May 1954 meeting of the AEC Commissioners reviewed “at length” the status of problems from fallout from Pacific test operations. That review decided it was “undesirable” for the “inhabitants of Rongulap atoll [sic]” to go back to island for a year.²⁰ The Commissioners decided that even though the Marshall Islanders were in “satisfactory condition,” they would still need a suitable home. In addition to these islanders, a Japanese fishing vessel, the *Lucky Dragon*, also “received considerable fallout in the test area.” Not only did these fishermen suffer from radiation poisoning, but the tests also caused worries about tuna contamination. Just as with the downwinders, these people too became part of the U.S. government’s uncontrolled experiment into radiation, human health, and the environment. The report to the Commissioners noted, “Japanese anxiety about the possible consequences of contamination had been caused in part, at least, by the prospect of the cancellation of orders placed by American firms.”²¹ Concerns

²⁰ Indeed it was not until April 1955 that the AEC Commissioners discussed the Marshall Islanders’ return to their homes at one of their meetings. The Commissioners found the Rongelap Marshall Islanders in good “general health and morale” and decided they could “be returned to their atoll shortly subject only to a number of limitations on diet and movement.” NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 8, Meeting No. 1078, 27 April 1955, 267.

²¹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 7, Meeting No. 984, 12 May 1954, 167-168.

about radioactive fish contaminated by this thermonuclear blast continued to be a problem for the United States.

An exchange of letters about fallout damage from the Bravo test can help illuminate the United States' position on the subject, showing an intense desire to downplay any wrongdoing while still being incredibly concerned about national safety. Jane Nishiwaki, a woman from the United States married to a Japanese biophysicist, expressed grave concerns in a missive to the President in late April 1954. John Bugher, Director of the AEC Division of Biology and Medicine responded to her on 1 June. Bugher forwarded his response to Sherman Adams, Assistant to the President on that same day and described Nishiwaki as a potential communist or communist sympathizer teaching at a mission school in Osaka, Japan. Bugher declared to Adams that he had to be very careful with his response, because anything he told her might end up in Communist hands. He did say, however that "the attachment to her letter, prepared by her husband, contains valuable technical information concerning the Japanese fishing ship which information we have been unable to obtain from the Japanese authorities in Tokyo."²² Thus Bugher well showed that issues of national security were paramount when dealing with concerns about radioactive fallout, but that the desire for knowledge meant communicating with Nishiwaki seemed like a good idea.

In Bugher's response to Nishiwaki, he tried to downplay most of her concerns about the damage of radioactive fallout from U.S. tests and emphasized U.S. control (of course, overt denial of a problem implies recognition that the problem may exist). The Biology and Medicine Director said that some of Nishiwaki's fears were unfounded, such

²² DDEL, White House Central Files, Confidential File, Box 9, Folder Atomic Energy Commission, Letter John C. Bugher to Sherman Adams, 1 June 1954 and Letter John C. Bugher to Jane Nishiwaki, 1 June 1954

as the fear that radiation might kill anyone. Bugher proclaimed that no one had died, and “As far as the patients who have been under American care are concerned, I can state that there is no serious permanent injury.” He said the Japanese patients seemed fine as well (these statements proved overly optimistic as deaths and severe illnesses would occur). Bugher’s response to Nishiwaki also downplayed the problem of contaminated fish, claiming that only the fish of the *Fukuryu Maru (Lucky Dragon)* had been contaminated, and none of those fish entered ports in Japan, Hawaii, or the United States. He continued, “I understand that a few cargoes of fish in Japan were found to have detectable but hygienically insignificant amounts of contamination.” Inspections found traces of radioactivity in two fish, but the levels in these “were substantially below that which would be important from a health standpoint. This, of course, does not minimize the importance of the very substantial market disturbance which occurred through fear rather than because of an actual radio-contamination danger.”²³ This statement did minimize, however, any concerns about radioactive fish from dangerous radioactive fallout by asserting that only unfounded fears could cause market disruptions.

Bugher’s most interesting assertion, however, downplayed the power of any U.S. bombs before the power of the natural world. He wrote, “Something of a proper perspective in these matters is given by the sad news of the loss of hundreds of fishermen and dozens of ships in the recent storm off northern Japan. Impressive as these man-made nuclear detonations may be, they are dwarfed by the frequently occurring manifestations of nature.” Whereas most of Bugher’s letter to Nishiwaki diminished the power nature had to affect human bodies (by carrying radioactive fallout), at this point the Director

²³ DDEL, White House Central Files, Confidential File, Box 9, Folder Atomic Energy Commission, Letter John C. Bugher to Jane Nishiwaki, 1 June 1954

accentuated the natural world's power. While the United States, per Bugher's comments, had well controlled the environment when it came to something like radioactive fish, humans certainly were powerless to stop something as mighty as an ocean storm. Bugher intended this statement to make U.S. thermonuclear bombs, even ones that were twice as powerful as anticipated and caused significant problems with the radioactive fallout produced, pale in comparison to natural occurrences completely out of human control. Thus Bugher's response to Nishiwaki treaded a fine line between asserting the United States' control of the situation and diminishing any power the nation (or any humans) had. He closed by reaffirming the need for nuclear tests, though, saying, "Finally, I am sure you will agree that devastating general war and tremendous suffering can be prevented only by keeping the free world overwhelmingly strong. To this end, personal inconvenience and some risks must at times be accepted by everyone of us."²⁴ What constitutes acceptable "personal inconvenience and some risks," of course, varies from person to person.

The July 1954 Semiannual AEC Report to Congress further elaborated on the problems stemming from the recent U.S. bomb tests, vacillating between accepting blame for the troubles and downplaying those issues. The report acknowledged that tests exposed both the Marshall Islanders and crew of the *Fukuryu Maru* to fallout radiation. It contradicted Japanese press reports of grossly contaminated fish, though, claiming, "Informed scientific opinion, borne out by recent continuous monitoring by the Federal Food and Drug Administration of tuna fish coming to the west coast from the Pacific fishing grounds, and further supported by several years' results of AEC marine biological

²⁴ DDEL, White House Central Files, Confidential File, Box 9, Folder Atomic Energy Commission, Letter John C. Bugher to Jane Nishiwaki, 1 June 1954

studies, provides no basis for alarm as to the consumption of tuna caught in the Pacific.” With this explanation, however, the report also admitted that after nuclear tests “radioactive debris is distributed by normal air currents over large areas and with sufficiently sensitive instruments may be found to encircle the globe.” This meant that surely some of the radioactive fallout ended up over the continental United States and indeed many commercial fisheries worldwide.²⁵ Nonetheless, concerns about radioactive fallout affecting living organisms, such as a July 1954 report from Formosa that “fish which have acquired slight radioactivity had been caught not far from the island,” continued to vex the AEC and its public relations, no matter if tests found such fish “well within acceptable limits.”²⁶

Correspondence between Dean Rusk and President Eisenhower in early 1955 highlights that both the public and the U.S. government took fallout radiation very seriously after the Upshot-Knothole Harry and Castle Bravo shots. The future Secretary of State, then President of the Rockefeller Foundation, wrote to the President on 23 February to say that at a recent Rockefeller board meeting “there was an extended and sober discussion of a matter of deep concern to you and to all thoughtful men and women, namely, the effects of atomic radiation on living organisms.” The Rockefeller Foundation had supported nuclear research for decades, but thought the “development of nuclear weapons poses grave concerns which bear upon a wide range of human concerns,

²⁵ *Sixteenth Semiannual Report of the Atomic Energy Commission, July 1954*, 51-54.

²⁶ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 7, Meeting No. 1014, 7 July 1954, 300. Indeed, publicity continued to be a problem in the future as well. On 10 June 1955 an article appeared in the *New York Times* that referred to a Mr. Ralph Lapp as a former AEC official when he in fact never had been connected to the Commission. The AEC Commissioners declared that they needed to inform people, especially the Joint Committee on Atomic energy, of this and of Lapp’s background “to correct any misapprehension that testimony by him on fall-out would be authoritative.” NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 8, Meeting No. 1088, 10 June 1955, 351-352.

from the lethal effects of ‘fall-out’ to the new avenues which might be opened for more abundant and healthful life.” Rockefeller claimed that the nation needed more knowledge to settle these concerns and the Trustees wanted to help explore the effects of radiation on living organisms, especially “the possible danger to the genetic heritage of man himself.” Rusk therefore approached Eisenhower seeking the President’s approval that the National Academy of Sciences engage such research with the Rockefeller Foundation’s financial support.²⁷

In his response several days later, President Eisenhower said he had been glad to receive the letter and generally focused on how, even though the United States had radiation problems under control, perhaps more research could be beneficial. Eisenhower emphasized that radiation problems did not come only from atomic bomb testing, but also from peaceful developments of the atom, clearly implying that stopping bomb tests alone would not control every problem associated with atomic development. The President wrote that he had discussed Rusk’s letter with AEC Chairman Lewis Strauss, who stated the Commission had already budgeted \$3 million a year “for its studies conducted in its own and university laboratories on various aspects of fall-out from weapon detonations, stack gases from atomic installations, the disposal of the wastes of separation processes, isotopes used in experimentation, etc.” Nonetheless, Eisenhower thought, “it may well be that much more can and should be done.” He thus promised to send the letter to Strauss so that the Commissioner might arrange a meeting with the Rockefeller Board of Trustees “to explore further [Rusk’s] very generous proposal.”²⁸ Rusk’s response thanked

²⁷ DDEL, White House Central Files, Official File, Box 450, Folder 10, Correspondence between Dean Rusk and President, Rusk to President, 23 February 1955

²⁸ DDEL, White House Central Files, Official File, Box 450, Folder 10, Correspondence between Dean Rusk and President, Eisenhower to Rusk, 28 February 1955

the President for his attention on the matter and said he would meet with Strauss on “whether there is a constructive and useful role for the National Academy of Sciences and the Rockefeller Foundation to play in this matter.”²⁹

Many U.S. Senators agreed with the general tenor that produced the Rusk-Eisenhower correspondence, trying to moderate fears of radioactive fallout with increased research. A month after the Rusk-Eisenhower correspondence, a group of them, led by Senator Frederick G. Payne (R-ME), declared that the number of nuclear tests was likely to increase in the future, not decrease, and that it was known that such detonations “can have serious deleterious effects, from an immediate and long-range standpoint, on human beings and other living organisms.” On 13 April 1955, these Senators therefore introduced Concurrent Resolution 22 of the 84th Congress that said, “Congress requests the President to instruct our chief delegate to the United Nations to take whatever steps may be necessary to propose and urge the formation of an international scientific commission within the United Nations to study and determine the effects on living organisms of radioactivity released by nuclear explosions.”³⁰ At this point, then, it is clear that many in the U.S. government had begun to take radioactive fallout from nuclear weapons quite seriously, especially the need to better understand it through increased research.

Senator. Payne sent a letter to Sherman Adams on Senate Concurrent Resolution 22 that underscored the growing attention paid to radiation fallout from testing with an eye toward international political maneuvering. Payne had introduced the resolution in

²⁹ DDEL, White House Central Files, Official File, Box 450, Folder 10, Correspondence between Dean Rusk and President, Rusk to President, 11 March 1955

³⁰ DDEL, White House Central Files, Official File, Box 449, Folder 8, Senate Concurrent Resolution 22, 13 April 1955

the Senate and twenty-seven other senators co-sponsored it. The Senator argued that adopting the resolution “would give the United States an opportunity to alleviate much of the fear of nuclear devices and the suspicion of itself which is so common in many parts of the world today.” Claiming that a great deal of foreign antagonism was directed at the United States because of radioactive fallout, Payne thought that if another nation ever called for an international nuclear testing moratorium the United States would be in a tough place without more knowledge (this proved quite prescient, as seen in Chapter Three). The Maine Senator wanted the United States to take the lead and exercise “moral leadership” to the world, as any U.S.-proposed commission would be less likely “to investigate or obstruct our testing program.” Finally, Payne concluded, “there is the possibility that an international group could reach some conclusions about the dangers of radioactivity which might well be of benefit to ourselves and our friends,” noting that if the Soviet Union did not agree “it would be another indication to the entire world of her utter disregard for the peace and security of all mankind.”³¹ The last few sentiments made clear that, while Payne thought radioactive fallout from tests damaged human bodies and world opinion of the United States, security and negotiating Cold War realities proved just as important in his moral calculus.

No matter how much policymakers in the AEC and White House focused on test radioactivity and its dangers, their decisions frequently reflected a desire to prevent or mitigate the tests’ political fallout, but not necessarily prevent altogether the radioactive fallout, as that would have required stopping nuclear tests. To deal with fallout that had already occurred, those in power needed more knowledge of environments and how

³¹ DDEL, White House Central Files, Official File, Box 449, Folder 8, Letter Frederick G. Payne to Sherman Adams, Assistant to the President, 21 June 1955

fallout affected those spaces. Sometimes, that knowledge merely served to allay fears, such as a report at the 28 June 1955 meeting of the AEC Commissioners that “no radioactivity attributable to Operation WIGWAM had been discovered by fish monitoring program on the west coast.”³² Wigwam was a test shot submerged 2,000 feet to test how deep underwater blasts affected submarines. At other times, such as ecological studies on coral reefs at the “Eniwetok Marine Biological Laboratory,” improved understandings both increased knowledge about the natural world and how fallout affected it. Those coral reef studies were “on whole plant-animal populations and ecological systems in the Central Pacific island areas used in atomic test operations.” Reckoning the effects of radioactive fallout on these systems required understanding the reefs’ ecology in its own right. Other research studied radioactivity, “natural or induced,” present in Pacific seawater and marine life. After taking measurements of the area (“temperatures, current characteristics, salinity, and radioactivity” at various ocean depths), researchers found “minute traces” of radioactivity that they said did not affect the safety of eating Pacific fish.³³

Research also attempted to determine radioactive fallout’s distribution pattern throughout the world, which proved highly dependent on environmental factors. As makes sense, the atmosphere and its conditions affected fallout more than anything else.

³² NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 8, Meeting No. 1093, 28 June 1955, 417.

³³ *Eighteenth Semiannual Report of the Atomic Energy Commission, July 1955*, 79-81, 90-93. The report also contained information, including a map, on fallout over the United States and how it affected the air and water. For information on how radioactive fallout affected the environment and animals at the Nevada Proving Grounds, see: NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 47, Folder Miscellaneous Reports on NPG and also Folder NPG 1955, Folder NPG 1954, and Box 48, Folder NPG 1953. For more on fish contamination, this time on concerns about radiation contamination of a shipment of yellowfin tuna in Portland, Oregon, see: NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 18, Folder Incident – Japanese Fish – Fallout

As one document on atmospheric fallout attested, the radiation could come in three types: local, tropospheric latitudinal, and stratospheric worldwide.³⁴ The size of radioactive particles governed both the height these reached and the rate of fall and determined which air currents would buffet those particles and thus direct how far these spread. Local fallout (more likely if the fireball from a detonation touched the ground) mostly contained larger particles, with smaller particles reaching the troposphere or sometimes stratosphere. Rain especially affected tropospheric fallout, and in this layer of the atmosphere radioactive fallout had a half-life (where half dissipated) of about three weeks. Global wind patterns meant a radioactive cloud, barring seasonal variations, could circle the earth in a month or two (slower from north to south than east to west, meaning latitudes with testing—the tropics—received more radiation from fallout than other latitudes). Stratospheric particles, on the other hand, fall extremely slowly and thus fell over the entire earth. Only around ten percent of what was stored in the stratosphere fell down into the troposphere each year, and once it left the stratosphere (and entered the troposphere) it would affect worldwide radiation levels.³⁵

How the atmosphere distributed fallout radiation throughout the planet played a significant role in the AEC's unplanned experiment into radiation, the natural world, and human health, even though this experiment went unrecognized. Thus research made its way to policymakers and showed a direct connection between the natural world (especially the atmosphere) and fallout distribution. To make good decisions about

³⁴ The Troposphere is the Earth's atmosphere up to ten kilometers high, well the Stratosphere is the layer ten to thirty kilometers high. These are followed by the Mesosphere, Thermosphere, and Exosphere (or outer space).

³⁵ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 47, Folder Miscellaneous Loose Papers Confidential (2 of 2), World-Wide Fallout, 1-4.

radioactive fallout, those in power needed to understand something about the environment and how fallout functioned in natural systems.

To gain such understandings about the connection between the natural world, nuclear tests, and human health, the AEC developed affiliations with other governmental organizations, particularly the Weather Bureau. Emphasizing this point, significant meteorological research at the behest of the AEC shows an important working relationship between the U.S. Weather Bureau and the AEC Division of Biology and Medicine.³⁶ As an example, the AEC used weather balloons to trace radioactive fallout, which involved meteorology and meteorologists in the research to detect and understand atmospheric radioactive fallout (Figures 13, 14, and 15).³⁷ Later research emphasized improving knowledge about radioactive fallout in oceans. As one Weather Bureau representative would claim in 1959, “It appears that we do not have the oceanic fallout under adequate control.”³⁸ And the relationship benefitted meteorologists, as well, since they could use fallout like a radioactive tracer to follow current patterns in the ozone.³⁹

Though testers did not intentionally do so, the fallout produced by blasts helped

³⁶ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 19, Folder General Files – Meteorology – General.

³⁷ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, Box 3, 1953-6, Folder Stratospheric Monitoring, Jan. 1958, #2, Constant Level, Balloons as Tracers of Air Motion in Atomic Weapon Tests for the Atomic Energy Commission

³⁸ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 2, Folder General Files – Fallout – Collection Analysis, Memorandum from Lester Machta to Hal Hollister, Subj: Oceanic Sampling, 16 November 1959. Machta was Chief, Special Projects Section, Office of Meteorological Research, U.S. Weather Bureau, Hollister was Division of Biology and Medicine of the AEC. This is likely one reason why October 1960 work occurred by the Scripps Institute into providing “a general description of the distribution of temperature, salinity, density, oxygen, and other chemical properties of the Indian Ocean – in particular the study of the changing circulation pattern under the influence of the monsoon winds.” NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 19, Folder Indian Ocean Expedition

³⁹ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 17, Folder Ozone contains correspondence on the subject and attaches an October 1960 article in the British journal *Endeavour* called “Radioactive tracers in the atmosphere” by N. G. Stewart.

meteorologists run experiments on global environmental phenomena. The Weather bureau, thus, became an integral part of the research to improve understandings of how fallout from testing moved throughout the earth and then fell back down to the planet.

Of course decision makers at this time frequently proved less concerned with how radiation affected the environment per se, but instead cared about how it might concentrate in human bodies and cause health problems. That is to say, since radiation from the environment affected bodies, policymakers did indeed care about the how testing put radiation in the environment. But that does not mean they necessarily held concern for how radioactive fallout damaged the environment or affected environmental health. Once fallout reached the ground, the “physical and chemical character of soils plays a predominant part in the entry of minerals into the food chain.” Strontium 90, with its half-life of 28 years, usually stayed in the top one to two inches of the soil. Cesium-137 (Cs^{137}) also affected environs and humans, but drew less interest. Some research thus focused on how plants, soil, Sr^{90} , and Cs^{137} all interacted (more in Chapter Four).

Important to decision makers, though, studies found that as strontium progressed through the food chain (such as through feed into cattle and then milk into humans), the ratio of Sr^{90} to calcium (the element Sr^{90} most modeled in biological systems) decreased. Since essentially all Sr^{90} and Cs^{137} that humans ingested came as part of their diet, biological systems themselves provided a bit of a buffer or resistance to depositing radiation directly into human bodies.⁴⁰ That is to say, the natural world would mediate the process as long as the fallout did not drop directly on human skin as happened to the downwinders after

⁴⁰ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 47, Folder Miscellaneous Loose Papers Confidential (2 of 2), World-Wide Fallout, 5-12.

the Upshot Knochle Harry shot or to the Japanese fishermen and Marshal Islanders after the Castle Bravo shot.

In 1956, the United States and the world showed an increased focus on fallout radiation and studying it, likely stemming from the deadly results of the Operation Castle Bravo shot.⁴¹ On 14 March, the United Nations convened its Scientific Committee of Atomic Radiation, especially concerned with fallout and the “effects of radiation on man and his environment.”⁴² The most significant program conducted by the United States was the Department of Defense’s Radiation Effects Program during Operation Redwing. That program’s primary purpose “was to obtain as complete documentation as possible of fallout from high-yield thermonuclear detonations” and especially study how radioactivity distributed itself throughout the atomic cloud; collect and characterize that fallout; and correlate data so that it could be extrapolated to land surfaces. This program found that most radioactivity stayed in the lower part of the mushroom cloud and, as seems logical, larger particles created the most radioactivity. With the data collected, researchers established what seemed to be a good cloud model, “which would allow more precision in predicting areas of local fallout, although it would not be possible to predict hot spots terribly well because of variation in wind.” And, lest anyone in the United States worry about the fallout created from these tests, the AEC assured that most of the

⁴¹ For various research on fallout, see “Longterm Effects of Fall-Out from Nuclear Weapons” in *Nineteenth Semiannual Report of the Atomic Energy Commission, January 1956*, 69. Also inquiries into dairy products, comparing the United States to the rest of the world in *Twentieth Semiannual Report of the Atomic Energy Commission, July 1956*, 106. Also see work using weather balloons to study Sr⁹⁰ and other nuclides at altitudes of 50,000 to 90,000 feet in NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 3, Folder #1 Stratospheric Monitoring, April 55 thru Dec. 57, Letter General Manager to Clinton P. Anderson.

⁴² *Twentieth Semiannual Report of the Atomic Energy Commission, July 1956*, 16.

Redwing test material ended up in Mexico.⁴³ In general, the Commission tried to establish that its nuclear tests posed no threats to the safety of either government personnel or to civilians. Efforts to assuage a worried citizenry even rose to public prevarications, saying that the AEC knew of no member of the public “to have suffered an overexposure to radiation as a result of living near atomic energy production or laboratory centers” or from weapons tests at the Nevada Test Site (where Upshot Knothole Harry was detonated).⁴⁴

Unsurprisingly, interest and focus on fallout continued to rise, and the years 1957 and 1958 saw U.S. policymakers pay more attention to the problem of radioactive fallout than they likely had in the previous fifteen years combined. For example, in April 1957 AEC Commissioner Willard F. Libby reported on the “Fireball Chemistry Project.” That endeavor considered “the ways and means of reducing the accessibility of radio-strontium in fallout to the biosphere and in particular to the human body. The basic technique is the incorporation of the radio-strontium in insoluble particles.” In essence, this meant putting perhaps a hundred tons of sand around a test weapon before firing it so that condensation of radioactive particles might happen within that sand and trap the radiation there.⁴⁵ And if reducing radiation in tests proved important, so did reducing fears about that radiation to the public.

U.S. decision makers on atomic matters worked hard to allay public anxieties about radioactive fallout as much as possible. For example, the AEC Commissioners tried

⁴³ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 9, Meeting No. 1238, 22 October 1956, 638-639.

⁴⁴ The AEC did admit that some unexpected weather conditions caused heavy radioactive fallout on four Pacific Islands—the Marshall Islands. *Twenty-First Semiannual Report of the Atomic Energy Commission, January 1957*, 112-113.

⁴⁵ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 18, Folder Fireball Chemical Project, Memo W. F. Libby to General Manager, 2 April 1957. The memo carbon copied all of the AEC Commissioners.

to explain in a *Parents* magazine article, “Long before nuclear weapons were even thought of, in fact, ever since people have lived on this planet, they have been subject to radiation from cosmic rays and from the radioactive material in the crust of the earth.” The article claimed that, while the media might make SR⁹⁰ seem quiet scary, the amount that had already fallen from all nuclear tests was roughly equivalent to what a person would receive in extra cosmic rays if he or she moved to a location about 300 feet higher in elevation.⁴⁶

Public apprehension was significant enough, though, that at his 5 June 1957 press conference President Eisenhower fielded a question about how “some top geneticists and other scientists have testified that fall-out radiation from nuclear weapons tests will damage hundreds of thousands and, perhaps, millions of the yet unborn in terms of physical deformities and shortened life spans.” The President brushed aside such concerns, however, referencing a previous report about how humans receive doses of radiation from all sorts of things they do every day. Diminishing the veracity of such claims, he added, “Incidentally, I noticed that [in many instances] scientists that seem to be out of their own field of competence are getting into this argument, and it looks like almost an organized affair.”⁴⁷ Eisenhower insisted that the U.S. government took its job

⁴⁶ NACP, 326 Records of the Atomic Energy Commission, Entry 81 A, Commissioner Harold S. Vance, Correspondence, 1955-1959, Box 2, Folder Memos to Chairman & General Manager, Memo H. S. Vance to Dr. Libby, 6 March 1957

⁴⁷ Eisenhower likely referred to something like a petition started by Linus Pauling, titled “An Appeal by American Scientists to the Governments and People of the World.” That petition stated, “Each nuclear bomb test spreads an added burden of radioactive elements over every part of the world. Each added amount of radiation causes damage to the health of human beings all over the world and causes damage to the pool of human germ plasma such as to lead to an increase in the number of seriously defective children that will be born in future generations.” It also said, “As scientists we have knowledge of the dangers involved and therefore a special responsibility to make those dangers known.” Questions existed as to whether the signing scientists actually could be considered experts, however. DDEL, White House Central Files, Official File, Box 451, Folder OF 108-A Atomic Weapons, Atomic and Hydrogen Bombs (8), Letter Linus Pauling to President, 4 June 1957 and Letter Sherman Adams to Linus Pauling, 29 June 1957. As could be expected, petitions were fairly common. One from University of Washington students claimed,

of protecting the nation very seriously and therefore the government had not stopped testing (even if it had tried to make those bombs cleaner).⁴⁸ This President intended this last comment to cause the public to question its perspectives and consider which was truly more dangerous—fallout from U.S. tests or the threat of communist hordes with their own bombs.

With public concerns about fallout rising, the White House developed a form letter to send to concerned citizens who wrote the President, which reflected a desire to moderate public opinion on the subject. The letter stated that the President certainly cared about the “possible hazard of fallout,” but that he also cared about the defense of the United States. The letter even cited former President Truman’s thoughts on the subject. It quoted Truman as saying, “Let us keep our sense of proportion in the matter of radioactive fall-out. Of course, we want to keep fall-out in our tests to the absolute minimum, and we are learning to do just that. But the dangers that might occur from the fall-out in our tests involve a small sacrifice when compared to the infinitely greater evil of the use of nuclear bombs in war.” Thus, the document presented the U.S. citizenry with a hypothetical choice; “a very small risk [of fallout] from testing or [...] catastrophe which might result from a surrender of our leadership in nuclear armament which has

“We, the undersigned, urgently recommend that the United States immediately discontinue its explosions of nuclear weapons, pending thorough investigation of the long-range effects of radioactive fallout. We further urge that the United States take the initiative in promoting similar steps on a worldwide basis.” DDEL, White House Central Files, General File, Box 1215, Folder 155-B, Jan. – Aug. 1957 (2), Petition from University of Washington students, 24 June 1957

⁴⁸ President Eisenhower later tried to clarify his comments about scientists working outside his field with a fairly conspiracy theory-minded assertion, saying, “I don’t know. I haven’t any idea, but I just say it seems to come up in so many places and so many different speeches, and you find scientists of various kinds other than geneticists and physicists in this particular field that have something to say about it.” DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 6, Press Conference 5 June 1957, Official White House Transcript of President Eisenhower’s Press and Radio Conference #112

been, we believe, the deterrent to aggression since 1945.”⁴⁹ In short, the statement told those concerned about fallout in no uncertain terms that dealing with “a very small risk” of fallout from testing was the only thing standing between them and communist Armageddon. White House staff also intended to attach, with the form letter, a copy of a report titled “Fallout from Nuclear Weapons Testing” by Charles L. Dunham, Director, Division of Biology and Medicine of the AEC.

Dunham’s summary report had a similar feeling to it as the form letter and also sought to dispel fears that concerned citizens might have held about nuclear testing. The Director of the AEC’s Biology and Medicine division claimed, “No environmental hazard nor substance to which human beings are exposed has been investigated so thoroughly as radiation and radioactive materials.” Dunham clearly explained that three principal dangers existed from radioactive fallout— leukemia, genetic damage to reproductive organs, and “bone irradiation” from intake of radiation such as Sr⁹⁰. In the end, though, the report claimed, “pathologists agree that while theoretically there might possibly be a very small addition in the amount of bone cancer over the world as a result of assimilated strontium-90 from fallout, the effects will be so small as to be undetectable, even statistically.” Genetic effects were not really such a problem either, according to Dunham.⁵⁰ In short, while those in positions of power cared about public opinion when it came to the dangers posed by radioactive fallout, the information those decision makers put back out attempted to diminish those concerns or convince naysayers that worrying about fallout meant a lack of concern about national security. A month later

⁴⁹ DDEL, White House Central Files, Official File, Box 451, Folder OF 108-A Atomic Weapons, Atomic and Hydrogen Bombs (7), Letter from Morse Salisbury to James G. Hagerty, 21 June 1957

⁵⁰ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 5, Folder Atomic Energy Commission 1958 (4), “Fallout From Nuclear Weapons Testing,” A Summary By Charles L. Dunham, M.D., Director, Division of Biology and Medicine, U.S. Atomic Energy Commission

when many citizens had received their AEC response letters on “the Fallout Problem,” Strauss reported that he felt gratified at the surprise and pleasure many of those recipients felt. He said, “the attention given to each of the hundreds of letters received has helped to dispel some of the misconceptions held by individuals about weapons testing.”⁵¹

Commissioner Willard F. Libby gave similar words of assurance during a 26 April 1957 speech that emphasized the importance of natural factors in combatting radioactive fallout from nuclear tests. The AEC reprinted the speech in its July 1957 report to Congress, assuring Libby’s talk reached a wider audience. Libby explained that fallout and its effects depended on many factors, including “not only contact of the fireball with the surface, but the nature of the surface, whether it be land or water and the type of soil and the composition of the water, whether fresh or sea water.” He further said that, as a rough rule, kiloton weapons stayed in the troposphere, but megaton weapons would enter the stratosphere. After this, fallout might enter plant systems and get eaten by animals (such as cows) that would then produce milk for human consumption. Since humans receive most of their calcium from milk, this represented the most dangerous source of Sr^{90} ingestion for humans. Libby somberly noted, “judging from experience with plants, insects, animals, and lower organisms, there is every reason to expect some genetic effects of radiation.” And yet the Commissioner downplayed such concerns in closing by saying, “In summary, then, we see that the present body burden of strontium 90 from atomic weapons tests in the United States corresponds to the radiation dosage to the bones which would result from a few hundred feet increase in altitude, and the present vital statistics show no observable effect on the occurrence of bone cancer or

⁵¹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 10, Meeting No. 1296, 26 July 1957, 378.

leukemia of much larger changes in altitude.”⁵² No matter what the gloom and doom crowd might say, the dangers from radioactive fallout once it entered the environments and biological entities with which humans most interacted resulted in less radiation damage than what a person moving from the East Coast to Denver might expect to experience. By extension, anyone who worried about SR⁹⁰ did so unnecessarily and without proper attention to the facts.

Those in positions of power also attempted to increase their own knowledge about fallout so that they could make the best decisions possible, or at least deflect criticisms as well as possible. In the summer of 1957, the AEC’s Willard Frank Libby communicated with Eilif Dahl of the Agricultural College of Norway Botanical Institute. Libby asked Dahl for advice about soils and fallout. Dahl confirmed Libby’s suspicion that plowing might reduce the amount of strontium that crops took in, provided it occurred in humid areas with plants that have shallower root systems (this seemed less important in arid areas where plants tend to have deeper roots). Dahl also confirmed that strontium fixation could happen in soil, meaning that the fallout would be stuck in the soil and therefore more likely to be absorbed by plants.⁵³

Another way to increase knowledge on fallout, like the Department of Defense had done with its Radiation Effects Program during Operation Redwing, was to increase research programs. Some endeavors sought to learn more about cleaning up past messes,

⁵² *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, Appendix 11 “Remarks Prepared by Dr. Willard F. Libby, Commissioner, For Delivery Before the American Physical Society, Washington, D. C., April 26,” 223-235.

⁵³ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 1, Folder Sunshine – General, 1957, Letter Eilif Dahl to W. F. Libby, 18 June 1957. Similarly, a research officer in the USDA sent a letter to a health Physicist in the AEC Division of Biology and Medicine thanking him for translating something from Russian about the behavior of fission products in soil. NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 1, Folder Sunshine - General, 1957, Letter F.D.H. Macdowall to Forrest Western, 14 August 1957

such as dealing with the Marshall Islanders affected by the Castle Bravo shot. By 1957, SR⁹⁰ had decreased sufficiently among the Marshall Islands, except among land crabs, as to allow human repopulation. The AEC figured that as long as the Marshall Islanders eliminated these land crabs from their diet and imported rice they would be fine.⁵⁴

In hindsight, the Marshall Islanders would not be fine. As described by anthropologists Barbara Rose Johnston and Holly M. Barker, island human populations suffered immensely as a result of U.S. nuclear weapons tests, particularly the Operation Castle Bravo shot. The authors contend that, beyond immediate health effects, the Marshall Islanders experienced incredible doses of long-term radiation exposure, suffered from bioaccumulated radiation from living in irradiated environments, and even encountered horrifying birth defects. Even worse, Johnson and Barker argued AEC scientists used their bodies as test subjects without the Marshall Islanders' consent, representing a significant ethical and scientific breach. Of course, some of these charges must be balanced with the real and necessary (even if ultimately insufficient) efforts to determine exactly how much the United States' tests had harmed the Marshall Islanders so that these peoples could be helped—where do medical investigations to help a population end and “biomedical research [...] conducted without meaningful consent” begin?⁵⁵

Of course in hindsight, the experiments involving the health of Marshall Islanders as they interacted with radioactive fallout highlight that widespread worldwide fallout unintentionally operated as a similar experiment on the entire world. The AEC investigated not only how fallout radiation had directly affected Marshall Islanders, but

⁵⁴ *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 132-135.

⁵⁵ Barbara Rose Johnston and Holly M. Barker, *The Rongelap Report: Consequential Damages of Nuclear War* (Walnut Creek: Left Coast Press, 2008), 23.

also how they might be further exposed to radiation from the local environments and especially their food supply.⁵⁶ Though not as direct as the Marshall Islanders, as radiation swirled around the world through the atmosphere, every human on the planet—especially those in the tropics—was affected. Thus by seeing how the fallout from nuclear tests affected ecosystems and human bodies, the AEC in essence ran a much less controlled experiment into radiation and human health. While the treatment of the Marshall Islanders is horrifying and shocking, what was intentionally done to them was at least partially done to much of the world, even if unintentionally.

In addition to health studies, the Commission also planned long-term ecological studies, such as large parts of Operation Plumbbob, emphasizing the importance of environmental understandings to understanding fallout. Any large test series represented a significant financial undertaking for the AEC, and thus Plumbbob's approval by executive policymakers demonstrates that they well understood and appreciated the importance of both fallout and the environment to understanding it. That test series began in 1957 and principally aimed to develop defensive nuclear weapons with reduced "off-site fallout," particularly using techniques such as "additional arrangements for forecasting of wind speed and directions."⁵⁷ Project 37 during Operation Plumbbob particularly studied the radio-ecological aspects of nuclear fallout, and the extended program shows an evolving emphasis on environmental aspects of fallout.

While previous focus from policymakers on fallout's relation to the natural world had typically manifested itself only on the subject of human health, Plumbbob's Project 37 research represented something new—a large research program directly into how the

⁵⁶ *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 132-135.

⁵⁷ *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 10-12.

environment responded to radioactive fallout. Overall, Plumbbob research attempted to construct a model to determine “the manner in which [physical, chemical, and biological] parameters are influenced by variations in time, detonation yields, heights, and types of support.” Particularly, Project 37 supplied researchers with massive data sets that measured the natural world and its features that could then be used to better understand fallout. More specifically, Project 37.1 on radio-ecological documentation of fallout areas “centered primarily upon the relative biological accumulation, fate, and persistence of fallout products within the local flora and fauna during the acute and chronic phases of contamination,” Project 37.2 “was responsible for obtaining and evaluating certain biophysical data associated with the fallout phenomenon,” and Project 37.3 on agricultural soils, crops, and livestock investigated “relations within human environments and food cycles. These studies were dictated by a need for field data on the potential consequences to man of nuclear fallout in agricultural areas.”⁵⁸ Thus even though the AEC frequently told the public it should not worry about the danger of fallout, as Eisenhower’s presidency progressed the Commission spent much more time, effort, and money into studying how to prevent and mitigate the radioactive byproduct of testing.

In fact, constant reassurances that problems from radioactive fallout were overblown and that the public should not worry cast a harsh light on a simple truth—the same agency that built and tested bombs was also the one charged with protecting the public from bombs’ adverse effects. George Clark, a civilian geologist, pointed out this problem in an August 1957 letter to President Eisenhower. Of course, he showed his own

⁵⁸ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 1, Folder World-Wide Fallout (Sunshine) – General 1958, Program 37, Civil Effects Test Group, Radio-Ecological Aspects of Nuclear Fallout: Introduction, Methods and Procedures, September 1957. The primary authors of the report were K. H. Larson, J. W. Neel, R. G. Lindberg, L. Baurmash, and G. V. Alexander.

biases by suggesting that the Geological Survey represented the ideal choice of civil servants to study the problem of radiation fallout.⁵⁹ But this letter nonetheless highlighted and explained the herky-jerky, back-and-forth nature of AEC communications, both intra-agency and to the public. The AEC spent a great deal of time and effort justifying the need for more tests and more information about atomic bombs and atomic energy in general. It thus makes sense that most of the facts and figures coming out of that organization (and those in the White House who received their information from the AEC) would downplay the severity of any potential atomic dangers. It is difficult, therefore, to distinguish between times when downplaying concerns reflected presenting up-to-date environmental science to the public and when it instead represented the AEC allowing its mission to improve nuclear weapons to override its goal of protecting the public from the radioactive fallout nuclear weapons tests produced.

Even internal documents, though, emphasized the perceived overblown nature of public fears about radioactive fallout. The AEC's Advisory Committee on Biology and Medicine submitted a report to the Commission on 19 October 1957 that put "The Problem" simply. It read, "The testing of nuclear weapons has injected into the atmosphere large amounts of radioactive materials in the form of dust of different particle sizes. These particles descend to the surface of the earth at different rates and constitute what is known as (radioactive) 'fallout.'" It also reminded readers that both Sr^{90} and Cs^{137} (especially Sr^{90}) manifested themselves in soils and milk and had long half-lives—if all weapons tests stopped at that exact moment, the report estimated that equilibrium of Sr^{90}

⁵⁹ Clark, a geologist with the Richfield Oil Corporation in Bakersfield, California, claimed the necessity of studying fallout was very real, though, saying, "Whether the danger is real or imagined, the need of the people for reassurance is a very real and valid objective." DDEL, White House Central Files, Official File, Box 450, Folder 1, Letter from George H. Clark to President, 6 August 1957

would occur in the 1970s and decline after that. The fission products also could cause significant health issues, such as genetic damage, leukemia, bone tumors, and the obnoxiously descriptive problem of “life shortening.” In the end, the advisory committee found such problems somewhat inconsequential, saying, “Judging from discussion in the public press, it is not generally realized that the estimated damage is well within tolerable limits, applicable to radiation exposure of the whole population in its normal peacetime activities.” Stepping out of its purview of biology and medicine, the advisory committee then claimed that the real question that needed answering was whether the size and number of bombs being tested was consistent with scientific and military requirements.⁶⁰

No matter their continued assertions that the U.S. populace should not worry about radioactive fallout, however, it is clear that U.S. policymakers did indeed care about what the public thought. In March 1957, the United States had declared that the nation intended “to conduct nuclear tests only in such manner as will keep world radiation from rising to more than a small fraction of the levels that might be hazardous.” This intention, however, meant that the United States wanted to do more testing to develop lower fallout weapons “so that radiation hazard may be restricted to the military target. This principle was first proved in the Pacific test series of 1956.” The January 1958 AEC report to Congress emphasized these ideas and also discussed other ways the United States had attempted to lower fallout of nuclear weapons, improving both bombs and public relations. Operation Plumbbob proved especially important in improving the knowledge necessary for lowering the fallout in nuclear weapons while only marginally affecting human health, per the AEC. Its report claimed, “Measurements and calculations

⁶⁰ Underlining in original. DDEL, White House Central Files, General File, Box 1216, Folder 155-B, July – Sept. 1958, Statement on Radioactive Fallout Submitted to the U.S. Atomic Energy Commission by the Advisory Committee on Biology and Medicine, 19 October 1957

of possible radiation exposures to the lungs as a result of *Plumbbob* fallout showed that the highest total accumulated dose (recorded at Eureka, Nev., with a population of about 500) was less than that to be expected from breathing for a period of 2 weeks air which contained only the amount of radioactive materials that occurs naturally.”⁶¹ No matter if U.S. leaders continually asserted that fallout did not post a significant hazard for the nation’s populace, the fact that U.S. actions frequently put more radioactive fallout into the natural world and human bodies meant that the government would have to keep defending its actions.

Nonetheless, the AEC continued to think of its mission as first being to protect the United States and believed the greatest threat to the nation came not from radioactive contamination, but from the Soviet Union. One memo from AEC Commissioner Harold Vance to the Commission Chairman Lewis Strauss claimed, “In order to put the Russians on the defensive end to swing world opinion behind the United States, it is suggested that we propose an agreement to suspend the testing and manufacture of so-called ‘dirty weapons’ leaving the way open for testing and manufacture of so-called ‘clean weapons.’” Chapter Three will examine much more in depth the talks between the United States and the Soviet Union on nuclear test cessation during the Eisenhower presidency, but it is important to know is that concern about fallout played a pivotal part in those talks. Vance put concerns about radioactivity quite bluntly, though, in his advocacy for continued nuclear testing to create weapons with lessened fallout when he said, “Both local and worldwide contamination from fallout would considerably reduce the fruits of a

⁶¹ *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 277-289. The report also included as Appendix 13 the Advisory Committee on Biology and Medicine’s “Statement on Radioactive Fallout,” roughly what was discussed above.

military victory.”⁶² Others thought studies of radioactive fallout should be a much greater part of public policy, and the U.S. government had to deal with both public complaints and questions about the legitimacy of its decision-making power.

In May 1958, scientist-activist Barry Commoner wrote an article in *Science* called “The Fallout Problem” that called for science to take a greater role in the management of public affairs because he believed the U.S. government did not hold a proper balance of protection against communists versus fallout. Commoner saw the problem as having two thrusts—scientists did not know enough about fallout (so knowledge should be improved through further experimentation), and the public needed better access to what was known so that they could, with scientists’ guidance, make better decisions. As for the science problem, Commoner explained it quite clearly, “In part, our present troubles derive from the unequal pace of the development of physics and biology. We understand nuclear energy well enough to explode great quantities of radioactive materials into the atmosphere. But our present knowledge of biology and its attendant sciences is not adequate for contending with the difficulties that follow when the radioactive dust settles back to earth.” Even before the scientific process advanced biological knowledge to a sufficient level, though, the article challenged scientists to marshal “the full assemblage of facts about fallout, their meaning and uncertainties, and report them to the widest possible audience.” And yet reporting to the public what was known (or believed to be known) about fallout frequently caused the public to want different policy decisions than policymakers wanted to make.⁶³

⁶² NACP, 326 Records of the Atomic Energy Commission, Entry 81 A, Commissioner Harold S. Vance, Correspondence, 1955-1959, Box 2, Folder Memos to Chairman & General Manager, Memo from H. S. Vance to Chairman, 10 February 1958

⁶³ Barry Commoner, “The Fallout Problem,” *Science*, Vol. 127, No. 3305 (May 2, 1958), 1023-1026.

Public criticisms of fallout and its effects on the environment and human bodies continued to exist and weighed heavily on the thoughts of decision makers, at least in determining how to dismiss or counter these. Alfred Phillips, a Democrat staunchly against nuclear testing, wrote a letter to President Eisenhower that asserted, “As a former member of the US Congress I believe and am reliably informed [he was not] that everytime an atom bomb is fired it will kill 500,000 children with cancer in the blood stream. Furthermore people think that the rains, the snows and the storms can be blamed on the atom bombs disturbing the upper air. Furthermore I have information that everytime an atom bomb is fired, everywhere on Earth, the upper air streams concentrate the dangerous fallout in New England.”⁶⁴ Another citizen claimed in a letter to Eisenhower, “the findings of science that this radio activity gradually created by nuclear tests represents a grave danger for all parts of the world, poisoning air, soil and water, affecting people, many fatally, for generations to come.”⁶⁵ Representative of a common viewpoint, many people in the United States believed nuclear fallout from testing (let alone the possibility of nuclear war) severely damaged the Earth’s environment, which then poisoned humans.⁶⁶ Thus the U.S. citizenry worried about nuclear weapons testing, despite reassuring words and releases from the AEC and even Senator Clifford Case’s claims that the United States “must not let our enemies succeed in using the fear of

⁶⁴ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, Apr. – June 1958, Telegram from Alfred N. Phillips to President, 8 May 1958

⁶⁵ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, July – Sept. 1958, Letter Worthington to President, 26 August 1958. Worthington self-identified as being from the “Middletown Monthly Meeting of Friends.”

⁶⁶ Fear of fallout from a nuclear war likely caused Secretary of State Dulles to write to Leo A. Hoegh of the Federal Civil Defense Administration asking for any literature on fallout “that could tell Mrs. Dulles, in simple terms, what she should install in the cellar to enable my household to utilize the protection against ‘fall-out’ which the cellar affords?” Hoegh replied with publications titled “Facts About Fallout Protection” (“states simply the problem and measures to be taken”) and also “Home Protection Exercises.” DDEL, John Foster Dulles Papers, General Correspondence and Memoranda Series, Box 5, Folder November 25, 1957 - April 3, 1958, Letter Dulles to Leo A. Hoegh, 2 April 1958 and Letter Hoegh to Dulles, 3 April 1958

poisoning the atmosphere—a fear felt increasingly by millions both in America and abroad—to halt our testing and development of weapons which may be essential to our very survival and to the protection of freedom everywhere on earth.”⁶⁷ To give it the ammunition to allay such concerns the AEC continued its research programs into fallout and radiation.

By mid-1958, the AEC had begun thinking about fallout in much more ecological terms and actually used that term to describe investigations “into the effects of strontium 90 on man and his environment, on the distribution, uptake, accumulation and eventual deposition in bone of strontium 90, and on methods of removing it from biological materials and from the soil.” At different sites, the AEC studied how different environments circulated and dealt with the fission products, especially interested in “the long-term effects of low-level radiation on plant and animal populations.” In one study at the Hanford nuclear processing plant, the AEC even created a “simulated natural pond” for the purpose of adding Cs¹³⁷ and studying its dissipation throughout the ecosystem. Other research uncovered that nuclear test shots from towers produced much greater amounts of fallout than did balloon-supported shots (the particle size dropped from forty-four microns in diameter to five when using balloons for the tests).⁶⁸ The AEC also conducted deliberately ecological studies in the Pacific, such as on Rongelap Island in the Marshall Islands.⁶⁹ Yet the Commission found some studies forced upon it.

⁶⁷ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, Apr. – June 1958, Remarks by Senator Clifford P. Case, Prepared for Delivery at Luncheon of Advertising Club of N.J. Honoring Secretary of Labor James P. Mitchell as New Jersey’s Outstanding Citizen of 1957, Essex House, Newark, N.J. Noon, Wed., April 19, 1958

⁶⁸ *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 196-201.

⁶⁹ See research on “Radiobiological surveys of the Pacific.” *Twenty-fifth Semiannual Report of the Atomic Energy Commission, January 1959*, 195.

In an incident more than vaguely reminiscent of the fallout-contaminated sheep in the Upshot-Knothole Harry shot, in 1959 the AEC investigated sick cattle in South Dakota. Floyd Fishel, a farmer living near Belle Pourche, South Dakota, claimed that fifteen of his yearling calves along with a few other cattle became ill from fallout radiation. The South Dakota Division of Radiological Health of the Public Health Service investigated these claims, as almost two years prior there had been a community-reported “radiation incident.” Investigators looked into the feedlots and hay storage and eventually decided that radiation had not killed the cattle; mucosal disease had. Their findings declared that radiation did not contaminate the hay “in sufficient quantity to be responsible for the death of his cattle, “ even if that hay was more radioactive than usual. In the end, officials hoped this analysis would be enough to prevent “what might have been another highly publicized radiation episode.”⁷⁰ Of course, it took the AEC almost two years to finally make such judgments, meaning that any public relations damage that could have been done already would have been. And any persons predisposed to distrust the U.S. government and Atomic Energy Commission on the subject likely would have found no reason to change their minds.

After the United States began test cessation talks with the Soviet Union on 31 October 1958, though nuclear tests had stopped for a time, matters of radioactive fallout and the threats it posed continued to stay in the public view. One March 1959 briefing on fallout said, “The data of the most recent [U.S. Public Health Surface] report show that

⁷⁰ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 16, Folder Radiation Incidents – South Dakota, 12 February 1959; also Letter G. J. Van Heuvelen to Francis J. Weber, 24 February 1959, with attachment Investigation of Reported Radiation Incident at Belle Fourche, South Dakota. Van Heuvelen was a doctor and State Health Officer for South Dakota, and Weber was Chief, Div. of Radiological Health of the Public Health Service

Sr⁹⁰ content of milk for the month of December has decreased from the high during the period following cessation of tests, but it is possible at any time for local areas to yield a high value over and above regional variation.” Of course, the ultimate measure of wheat contamination eventually would be the degree to which it affected human bones, and these high readings of radioactivity in wheat provoked anxiety. Concerns existed about other foodstuffs as well, and particularly high measurements of radiation in Minnesotan wheat caused the AEC to respond to public concerns.

At their 6 March 1959 meeting, the AEC Commissioners discussed an upcoming cabinet meeting with the President on that radioactive Minnesotan wheat and the need to respond to public concerns about it. Results from examinations in 1957 had been recently released that showed the levels of radioactivity in some Minnesota wheat had been between 105-155 sunshine units (the measurement for Sr⁹⁰ contamination, after Project Sunshine), which exceeded the maximum permissible level in human bones of 50-100 units. However, the amount of radiation in the wheat would in no way directly translate into the same amount in human bones if consumed, and Commissioner Willard Libby reported, “if an individual ate only ‘hot’ wheat all of his life, he might approach the radioactive tolerance limit.” Libby further explained that he thought, “the lack of public understanding of radioactive fallout was an educational problem.”⁷¹ Such an assertion implied that worrying about radioactive fallout in this case represented ignorance—anyone with the proper education would have the right perspective and know that this wheat posed no real danger.

⁷¹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1482, 6 March 1959, 190.

At that cabinet meeting with President Eisenhower on the same day, Dr. Libby talked about the same radiation issues in Minnesotan wheat, which shows that the matter was of enough importance that the President himself became involved. Libby again explained that the maximum permissible levels of radiation ranged from 50-100 sunshine units, in contrast to the present general level of just one or two units. In a moment of candor, however, the Commissioner remarked that this top amount allowed was the AEC's worker tolerance level, even though the true level at which deleterious effects might be expected was still unknown. Since it was impossible to run intentional experiments on human bodies the AEC had not done so, but Libby "concluded by estimating the hazard of radiation to be very small compared to other hazards of life." Thus even though the wheat in Minnesota had been the most contaminated found, likely due to a combination of both U.S. tests and "particularly the extremely 'dirty' tests of the Russians last October," no real danger existed.

In the end, the meeting emphasized both executive decision makers' commitment to nuclear testing and the fact that nuclear tests functioned as unplanned experiments on the nexus of human health and the environment. Near the end of the meeting, the participants again emphasized that the United States needed to keep testing to develop cleaner weapons for use in any hostilities. The meeting minutes finished, "The President concluded the discussion with a comment on the difficulty of any assumption there could be a nuclear war, since the radioactivity level from a massive attack would be just tremendous compared with what is evident in Minnesota wheat as the result merely of a few tests."⁷² After nuclear tests temporarily ceased for test cessation treaty talks in 1958,

⁷² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Cabinet Series, Box 13, Folder Cabinet Meeting of 6 March 1959, Minutes of Cabinet Meeting, 6 March 1959

though, the worldwide levels of radioactivity in food continued to drop and officials had a plan that if civilians started to worry because of any news stories they should be reminded that “Temporary rise in strontium levels in one or some foods need cause no concern; it is [the] long-term average [over an] entire diet that counts.”⁷³ No matter the levels, though, it is clear that when the unintentional experiment conducted by the AEC affected persons out of the United States it was one thing, but when domestic health was involved it was entirely another. A cabinet-level meeting with the President over contaminated domestic wheat emphasizes the importance of geopolitical factors, and also an affirmation that serious problems existed when the experiment touched the United States. Thus the meeting also represents how seriously the U.S. government frequently took its mandate to protect U.S. citizens in concept, even if its actions sometimes reflected other priorities.

Of course, no matter what the President declared, the public continued to have strong concerns about nuclear fallout. At their 17 April 1959 meeting, the AEC Commissioners discussed whether or not the AEC should provide testimony on the scientific aspects of fallout at the upcoming fallout hearings held by the Congressional Joint Committee on Atomic Energy. Beyond scientific and moral questions about whether the AEC should participate, the Commissioners had to decide whether the Commission joining the hearings would do any good at all. Commissioner Harold Vance thought that no education campaign could ever fully allay public concern about fallout. “Therefore, since all fallout to date has resulted from nuclear weapons detonations in the

⁷³ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 18, Folder General Files – Fallout – Foods, Telegram on strontium in foods

atmosphere, the only way to eliminate this public concern is to achieve an international agreement banning all atmospheric weapons tests.”⁷⁴

The AEC’s reports to Congress for 1959 and 1960 contained a smorgasbord of information on fallout and reflected a very different organizational state than when Harry Truman had been in office. The AEC reported on everything from a medical reexamination of the Marshall Islanders to Sr⁹⁰ levels in soils around the world and gave a “Chronology of Fallout Studies.” An appendix after the 1959 report even focused specifically on the fallout from tests at the Nevada Test Site, discussing the approximately one megaton of fission energy released there from nuclear detonations and what happened to the 400-600 billion curies of radiation those produced.⁷⁵ The report on 1960 marked the last time that the AEC would focus as much on fallout as it did that year as an executive order in August 1959 had assigned the responsibility “for monitoring environmental levels of radioactivity resulting from fallout” to the Department of Health, Education, and Welfare, giving “that agency primary responsibility within the executive branch of the Federal Government for the collation, analysis, and interpretation of such data.” After 28 April 1960, the AEC started giving all of its information to that Department for them to publish, meaning the section in the 1960 report on “Fallout Measurements In Foods And In Man” would not be under the AEC’s purview in the future.⁷⁶

On 7 November 1960, the AEC Office of Technical Information produced an informational pamphlet on the “Program of the United States Government in

⁷⁴ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1493, 17 April 1959, 255.

⁷⁵ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 191, 239-259, Appendix 15 “Fallout from Nuclear Tests at Nevada Test Site” (pp. 559-572).

⁷⁶ *Annual Report to the Congress of the Atomic Energy Commission for 1960, January 1961*, 176-179.

Atmospheric Radioactivity” that summed up the available knowledge and thought patterns at the time. Fallout sampling had improved dramatically over the years and involved aggregating the work of many different agencies and contractors who, in separate efforts, created a great deal of data on the subject, even though studying fallout had not been the original reason for producing the data sets. Thus the booklet described a network created over two presidencies, but more importantly depicted an institutional desire to learn more about radioactive fallout and how it entered and affected the natural world and human bodies. The two basic objectives of U.S. fallout programs were understanding both the relationship between atmospheric radioactivity input and the meteorological factors that led to the space-time models of fallout and also understanding the factors between surface deposition and surface air concentration to develop a model to predict distribution. As the author stated, “In summation, it is my feeling that the total level of effort will increase; that the scope will shift but that basic program objectives will not change; that complexity will increase greatly in facing the nuclear power and the space age atmospheric radioactivity problems.”⁷⁷ A sea change in focus on fallout was evident by the end of Dwight Eisenhower’s term, as illustrated by the Office of Technical Information’s 1960 publication.

When the United States detonated the world’s first atomic bomb at Alamogordo in 1945, the nation’s scientists unleashed more than just a brilliant flash of energy—they also created the world’s first radioactive fallout. Even though fallout became a known issue at the time, U.S. policymakers did not take the radioactivity as seriously as they

⁷⁷ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 14, Folder Fallout – Atmospheric Radioactivity, George T. Anton, “Program of the United States Government in Atmospheric Radioactivity,” 7 November 1960, 2-14.

would a decade later. Attention on the subject instead increased slowly over time, and two events early in the Eisenhower administration—the poisoning of downwinders after the Upshot-Knothole Harry test shot in 1953 and the Operation Castle Bravo test shot in 1954—brought the nation, and indeed the world’s focus to bear on the radioactive particles. Because of these two formative events, paired with a focus that had been increasing anyway, fallout held a much greater place of importance during the Eisenhower presidency than it had for his predecessor. The end result was that Eisenhower’s administration cared much more about how nuclear tests (via fallout) affected the environment and human health than had his predecessor’s government, especially due to a consistent incorporation of environmental science into policymaking at the highest levels. Sometimes, however, this caution existed only to create the necessary knowledge and justifications to deal with public criticisms and to keep testing nuclear weapons in the name of national security.

Executive decision makers were very conscious of the many experiments they commissioned to improve nuclear bombs and better understand fallout, both often in the name of national security, but proved less conscious of the fact that their actions in essence turned the entire world into a laboratory and every human on it into a test subject. Nuclear fallout settled over much greater distances than initially believed and the most powerful tests even cast radioactive particles all over the entire world. Directly testing the effects of Sr^{90} and Cs^{137} in human bodies proved impossible, and therefore scientists were not exactly sure of how fallout might harm those affected. But by injecting those radioactive elements into the atmosphere that is exactly what they did. Radioactive Strontium and Cesium, once put into the atmosphere, eventually settled back to the

planet's surface and entered ecosystems where, sooner or later, these frequently ended up in human diets. Only then could anyone know exactly how radioactive fallout might affect humans and our health.

Thus radioactive fallout and the decisions made by those in power represent a distinct moment in U.S. history where issues of national security, environmental knowledge, and human health converged into one single issue about how nuclear weapons testing should occur. This confluence of factors led policymakers to consider both the environment and human bodies as integral parts of their national security decisions, as they had to balance keeping the United States safe in a geopolitical context while still safeguarding its peoples from radiation poisoning. The AEC consistently decided that protecting the nation meant continuing nuclear tests, but doing so required caring about what those tests did to the natural world. It would be easy to say that U.S. policymakers consistently sacrificed environmental and human health for perceived safety with nuclear weapons, but that interpretation ignores all of the work to reduce fallout from tests and study the effects of any fallout that bombs did make. The truth is that decisions about nuclear fallout encompassed all of these factors and decision makers balanced these issues as they thought appropriate. Some of their choices had incredibly damaging effects that irrevocably harmed human bodies and extensively damaged ecosystems. But that does not mean that the environment, especially via environmental science, did not matter to U.S. policymakers—it just means that they thought that alternatively sacrificing national security was a worse option than continued testing that spewed radioactive fallout into the atmosphere.

Chapter Three

Cold War Environmental Diplomacy: Nuclear Test Cessation Talks During Eisenhower's Presidency

On 3 March 2011, Stephen Colbert, the host of Comedy Central's "Colbert Report," snarkily remarked on the social media site Twitter, "Scientists say nuclear war could stop global warming. I don't know about that, but things will definitely cool off without all that skin."¹ This mirth-filled outburst poked fun at the idea of an atomic holocaust; a sentiment that likely elicited laughs in the twenty-first century, but would have seemed entirely inappropriate to peoples of the 1950s. During that decade, the possibility of Soviet bombs destroying most of the United States (or vice-versa) felt like a very real possibility. Even if a nuclear attack never ended humanity as so many feared, the inherent threat of atomic testing loomed heavily in the minds of millions.

It was not until 1963, several years after Dwight Eisenhower left office, that a treaty to ban certain nuclear testing emerged. Credited as one of President John F. Kennedy's real successes, the 1963 Partial Nuclear Test Ban Treaty banned tests in the atmosphere, outer space, and underwater—all environments where any nuclear detonation could be detected from outside the testing country. These environments also constituted the places where nuclear testing would do the most damage to environmental and human health. Thus the treaty also represented one of the first major moments where international concern for the environment helped lead to a political truce between hostile nations, as concern for nuclear fallout provided a major impetus for the test ban. In 1965, Barry Commoner called the 1963 treaty "the most important social action ever taken to conserve the quality of water, air, and the soil," dubbing radioactive fallout from nuclear weapons testing the "greatest single cause of environmental contamination of this

¹ Stephen Colbert tweet (@StephenAtHome), 3 March 2011, 12:02pm

planet.”² Even owing to the inherent intersections of environment and international relations, the role played by the natural world in forming this treaty has gone relatively unacknowledged.

This chapter tells the story of nuclear test cessation talks during the Eisenhower Presidency from the United States’ perspective with particular attention paid to the importance of environmental science in those discussions. Focusing on personnel from the White House and the Atomic Energy Commission (AEC), the chapter shows that the Eisenhower-era talks reveal a growing environmental consciousness, even if policymakers did not explicitly recognize or admit this connection. Concern for how nuclear testing might affect the environment and, in turn, human health underlay the entire series of negotiations. Knowledge about earth systems and ecology played a crucial role in the talks, especially in regards to detecting possible blasts. The United States would not budge on the issue of proper control measures to detect potential treaty violations. Since continually improving understandings of how the earth functioned was the only way to improve detection systems, environmental knowledge played a crucial role in the talks. In the end, this even led to an institutional position that valued improved environmental knowledge about the nuclear complex for how it could enhance U.S. national security. Simply put, the Eisenhower-era nuclear test ban talks cannot be fully understood without considering the role played by scientific understandings of the environment.

Studies of the nuclear test ban treaty and its previous negotiations began soon after the inking of the official Limited Test Ban Treaty in 1963.³ From early on, most

² Barry Commoner, “Conservation of the Water Resource: The Responsibility of the Scientist,” *Journal (Water Pollution Control Federation)*, Vol. 37, No. 1 (Jan. 1965), 60.

historians seemed to recognize that, even though the treaty did not come to fruition until the Kennedy administration, the international agreement had a longer history based on technological and scientific understandings of more than a decade.⁴ According to historian Robert Divine, for example, the Eisenhower-era nuclear fallout from testing, and how U.S. leaders and citizenry responded to that matter, presented the central issue in the nuclear treaty's development. He particularly found importance in the conflict between scientists and the defense community over the effects, harmful or not, of radioactive fallout.⁵ And yet public history, at times, has mostly forgotten the role played by President Eisenhower's administration leading up to the 1963 Limited Test Ban Treaty. As an example, the webpage for the Kennedy Presidential Library has three pages on the 1963 treaty, but essentially only three sentences on negotiations during the Eisenhower era.⁶

Many more recent accounts, on the other hand, privilege events during the Eisenhower presidency as an essential backdrop to the eventual 1963 treaty, with the

³ Egon Schwelb produced a study of the treaty's legal ramifications in 1964, pointing out many somewhat unresolved issues remained. Egon Schwelb, "The Nuclear Test Ban Treaty and International Law," *The American Journal of International Law*, Vol. 58, No. 3 (July 1964), 642-670. The first historical study came two years later. Harold K. Jacobson and Eric Stein, *Diplomats, Scientists and Politicians: The United States and the Nuclear Test Ban Negotiations* (Ann Arbor, University of Michigan Press, 1966) And, unsurprisingly, not everyone found the treaty to be in the United States' best interest. James McBride's military and political study, partially historical in nature and terribly biased against the Soviet Union, found the Test Ban Treaty "prejudicial to the security of the United States." James Hubert McBride, *The Test Ban Treaty: Military, Technological, and Political Implications* (Chicago: Henry Regnery Company, 1967), vi.

⁴ Nobel Laureate and former AEC Commissioner Glenn Seaborg's account of the treaty talks approaches a hagiography of Kennedy. Based largely on Seaborg's personal diary, the work claims that during Eisenhower's presidency, "Little of significance was accomplished" on the treaty. Glenn T. Seaborg, *Kennedy, Khrushchev, and the Test Ban* (Berkeley: University of California Press, 1981), 25. Kendrick Oliver's work, a much fairer account, also privileges the events of the Kennedy era while downplaying the possibility that an agreement might have been reached by Eisenhower's administration. This seems understandable in some ways, though, as the book focuses on the U.S.-U.K. interactions during the negotiations and not necessarily on portraying a holistic history of the treaty. Kendrick Oliver, *Kennedy, Macmillan and the Nuclear Test-Ban Debate, 1961-63* (New York: St. Martin's Press, Inc., 1998)

⁵ Robert A. Divine, *Blowing on the Wind: The Nuclear Test Ban Debate, 1954-1960* (New York: Oxford University Press, 1978)

⁶ "Nuclear Test Ban Treaty" on the John F. Kennedy Presidential Library and Museum website, <http://www.jfklibrary.org/JFK/JFK-in-History/Nuclear-Test-Ban-Treaty.aspx>, accessed 22 February 2012

most vigorous debates surrounding the possibility of whether the Kansan President ever had a legitimate chance to forge a test cessation deal and the role he played in those talks. Contrary to then contemporary historical consensus, Per Fredrik Pharo argued that external events had little to do with the development of the test ban negotiations. Instead, Pharo believed constant factors in the U.S. position proved much more important in explaining why talks remained deadlocked during Eisenhower's terms. Pharo argued that the United States would not tolerate uncertainty in its national security, especially in relation to nuclear weapons, and that the uncertainty surrounding underground test detection meant the United States would never sign a treaty banning tests without on-site inspections, something to which the Soviet Union would never agree.⁷ On the other hand, Martha Smith-Norris, in her history of the talks, claimed that the discussions failed for two different reasons—not all U.S. agencies supported a test ban and, perhaps more importantly, Eisenhower remained “largely uncooperative” when it came to supporting the talks and tended to side with the military.⁸ Benjamin Greene took a much kinder view of Ike and argued that the President truly wanted a test ban treaty as early as 1954, but allowed those who controlled the presentation of scientific advice to him (particularly AEC Commissioner Lewis Strauss) to sway his policies.⁹ These differing perspectives

⁷ Pharo particularly argues against the interpretation set forth in Stephen Ambrose's 1984 *Eisenhower: The President*. Per Fredrik Ilsaas Pharo, “A Precondition for Peace: Transparency and the Test-Ban Negotiations, 1958-1963,” *The International History Review*, Vol. 22, No. 3 (September 2000), 557-582. Of course, finding fault with Stephen Ambrose became much easier in the later years of his career after significant plagiarism charges, compounded by the fact that Ambrose likely fabricated many of the interviews that formed a significant bedrock for his study. Richard Rayner, “Channelling Ike,” *The New Yorker*, 26 April 2010. http://www.newyorker.com/talk/2010/04/26/100426ta_talk_rayner Accessed online 27 February 2012.

⁸ Martha Smith-Norris, “The Eisenhower Administration and the Nuclear Test Ban Talks, 1958-1960: Another Challenge to Revisionism,” *Diplomatic History*, Vol. 27, Iss. 4 (August 2003), 503-504.

⁹ Greene presents Eisenhower's relationship with Strauss as one that did not work out in the President's favor, and claims the treaty did not happen during Eisenhower's term for a variety of reasons, chief among them being scientific advice, “the central variable that explained Eisenhower's decisions during his second term in office and a critical factor for understanding the evolution of his approach to a test ban throughout

have added to a vigorous scholarly debate, but none of them showed the important role played by environmental science and concerns about natural systems and human health in the talks.

It is not the purpose of this chapter to weigh in on more recent scholarly debates, although some common sense might be useful when considering them. Like any historical subject, the causes and effects of the Eisenhower-era test ban talks were complex. What is clear, however, is that the 1963 treaty only banned tests in environments that could be detected from outside the territory where that testing occurred. In short, the eventual treaty looked very similar to some of the Eisenhower administration's initial requirements and proposals, as will be seen later in the chapter. Whether Eisenhower and his negotiators truly were serious about or capable of negotiating a viable treaty at the time or not, Kennedy's eventual Partial Test Ban Treaty neatly fit into a perspective firmly established by Eisenhower and his administration. Also clear from the published literature is that scholars have not yet recognized the role of both the environment and environmental science in treaty talks.¹⁰ Historians have begun to recognize the importance of the environment in world political affairs, evidenced by the September 2008 volume of *Diplomatic History* that was co-sponsored

his presidency." Benjamin P. Greene, *Eisenhower, Science Advice, and the Nuclear Test-Ban Debate, 1945-1963* (Stanford: Stanford University Press, 2007), 6.

¹⁰ One slight caveat to this statement might be that Toshihiro Higuchi's "Atmospheric Nuclear Weapons Testing and the Debate on Risk Knowledge in Cold War America, 1945-1963" argued, "The pursuit of national security led, ironically, to the creation of environmental insecurity in the form of radioactive fallout. To contain that insecurity, Washington attempted to impose an assessment of the risk posed by radioactive fallout that would serve as a standard for its own citizens and the international community." Toshihiro Higuchi, "Atmospheric Nuclear Weapons Testing and the Debate on Risk Knowledge in Cold War America, 1945-1963," in *Environmental Histories of the Cold War*, J. R. McNeill and Corinna R. Unger, eds., (New York: Cambridge University Press, 2010), 302.

by *Environmental History*, but more work is needed.¹¹ This chapter continues those efforts in its study of the Eisenhower-era nuclear test cessation discussions.

In a public statement on potential nuclear disarmament, Dwight Eisenhower laid out his position on test cessation in the fall of 1956, and in explaining his reasoning he set up the U.S. position for talks that focused on safeguarding the environment and adequate detection systems. While disarmament and test cessation certainly are separate issues, at this time many policymakers conflated the two, or at least saw test suspension as the first step toward a disarmament plan. Therefore, although it was not expressly about test cessation, this statement still laid out many of the United States' positions and concerns on the subject. Eisenhower told the nation's people he considered it "in the public interest" to give "a full and explicit review of [U.S.] policies and actions with respect to the development and testing of nuclear weapons, as these affect our national defense, our efforts toward world disarmament, and our quest of a secure and just peace for all nations." After that, the President emphasized that preventing the use of weapons in war was a crucial goal of the United States, and he stressed two tasks of the nation. The first was that the United States should "seek assiduously" to develop international agreements to "promote trust and understanding among all peoples." The second point, seemingly in contrast with the first point, was that the U.S. should create nuclear weapons of both a high enough quality and quantity "to dissuade any other nation from the temptation of

¹¹ Historians Kurk Dorsey and Mark Lytle, in their introduction to the roundtable issue, called the separation between environmental and diplomatic histories "increasingly untenable." Kurk Dorsey and Mark Lytle, "Introduction," *Diplomatic History*. Vol. 32, No. 4 (September 2008), 517.

aggression.” Eisenhower elaborated, “Thus do we develop weapons, not to wage war, but to prevent war.”¹²

Yet even with a focus on advancing its nuclear arsenal, Eisenhower told his constituents that the United States had no desire to destroy the world and in fact wanted to reduce the danger nuclear weapons presented to the world. The President told his people—and the world—that the U.S. government had been “unremitting” in trying to “ease the burden of armaments for all the world, to establish effective international control of the testing and use of all nuclear weapons, and to promote international use of atomic energy for the needs and purposes of peace.” But the nation also insisted on establishing effective safeguards or controls in any disarmament program. Eisenhower maintained that the only reason such a program had not yet happened is that the Soviet Union had not accepted any “dependable system of mutual safeguards,” rejecting fourteen U.S. proposals over the previous two years. Without Soviet cooperation, Eisenhower declared that the U.S. had continued to enlarge its stockpile of nuclear weapons and would continue testing them.¹³

Eisenhower presented a complicated duality surrounding human health and the environment, however, when he tried to explain that both the reason to stop nuclear tests and the reason to keep testing going both centered on reducing nuclear fallout. The President claimed that hydrogen bomb tests were safe and did not endanger human health (much closer to a prevarication than being entirely truthful). He also explained that the United States needed to continue testing to reduce the fallout of future bombs the United

¹² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956, 1.

¹³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956, 2.

States might use in warfare, either as offensive or especially defensive weapons. Fallout represented a particularly important issue to many in the world after the 1954 Castle Bravo hydrogen bomb test in the Pacific Ocean produced much more radioactive fallout than anticipated and created a public relations nightmare, especially concerning a Japanese fishing vessel (the *Lucky Dragon*) it covered in the toxic substance. The President continued that all nuclear bombs, no matter their size, produce fallout, and “Thus, the idea that we can ‘stop sending this dangerous material into the air’ – by concentrating upon small fission weapons – is based upon apparent unawareness of the facts.” Testing bombs would always lead to some fallout, no matter the size of weapon tested, but continued tests might reduce the fallout from future detonations.¹⁴ Reducing the atmospheric and environmental contamination nuclear tests produced in the form of radioactive fallout and getting the toxins out of “the air” comprised one of the few ways to make nuclear testing safe, or safer, to humans.

Even in this first speech, though, Eisenhower put his finger directly on the sticking point of all negotiations to come during his term—detection systems and environmental knowledge. He told the U.S. people that the Soviets wanted “plans for disarmament [...] based on simple voluntary agreements. Now, as always, this formula allows for no safeguards, no control, no inspection.” The President feared that simply trusting the Soviet Union might lead to serious problems. If the U.S. honored the test cessation agreement, but the USSR did not, the U.S. could lose its lead in nuclear weapons technology. This could cause a “serious military disadvantage” for the United

¹⁴ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956, 3.

States if research continued without testing.¹⁵ Either way, for test detection systems to function properly, the negotiating parties needed nuanced understandings of how nuclear bomb detonations influenced the earth, especially in how these put fallout into the atmosphere at different altitudes and caused tremors if detonated close enough to the ground. In essence, closely observing and measuring the earth and its systems constituted the only way to monitor for possible treaty violations.

Eisenhower's statement, following this reasoning, ended with two conclusions premised on protecting both national security and the natural world. The President first argued the United States needed to keep developing nuclear weapons "until properly safeguarded international agreements can be reached" and do so "for the sake of our own national safety, for the sake of all free nations, for the sake of peace itself." Eisenhower's second point was that the country also must try to reach some level of world disarmament for the safety of both the nation and the world.¹⁶ These conclusions, and the logic that preceded them, set up the general U.S. position for the next several years. Clearly nuclear weapons, used in aggression, defense, or in tests, represented a threat to humans and the environment from fallout. However continued testing would help the United States maintain its military supremacy and could reduce the threat of radioactive fallout from future bombs, even though such tests still polluted the planet and endangered the world populace. Eisenhower also took a position that the only thing standing in the way of some sort of international agreement was Soviet intransigence and the USSR's inability to agree to perfectly reasonable inspection plans. Fundamentally, disagreements over

¹⁵ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956, 3-4.

¹⁶ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 4, Folder Atomic Energy Commission 1955-56 (2), Statement by the President, 24 October 1956, 4.

inspection plans were crucial from the outset to the Eisenhower administration. As President Eisenhower's pre-press conference notes from 22 May 1957 told him to respond if questioned about whether aerial inspection planes, necessary for "adequate inspection," might be armed, he was told to respond, "they will be, with cameras, not with bombs."¹⁷

Disarmament continued to be the issue in 1957, although concerns over fallout and nuclear testing formed a crucial part of that debate. At a 5 June 1957 press conference, a reporter questioned President Eisenhower about how he planned to deal with the country's "anxiety" over fallout and whether he intended to modify plans about testing. The President responded, "the plans that we have for testing are all bound up in the plans we have for disarmament, which we think is necessary." Eisenhower continued that tests were necessary, as when scientists "believe they have found something that makes [bombs] cleaner, better, more efficient" they need to test the new weapons. Later in the press conference, someone again questioned the President about disarmament and he responded that the United States could only support disarmament if it was agreed that there would be no more atomic bombs in war. He explained, "we couldn't enter into any program which forever banned tests unless we also had a system which we knew would and could be convinced would, forever ban the use of weapons, of these weapons in war."¹⁸ Thus even in the summer of 1957 it was clear that disarmament, nuclear tests, and fallout were intertwined issues to Eisenhower.

¹⁷ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 6, Press Conference 22 May 1957, Pre-press conference notes

¹⁸ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 6, Press Conference 5 June 1957, Official White House, Transcript of President Eisenhower's Press and Radio Conference #112, 7, 11.

Later in the month, Eisenhower again received queries on testing and showed a focus on testing's necessity for reducing nuclear fallout. One reporter declared that there seemed to be "a hesitancy on the part of the government to an unequivocal yes or no on this business of immediate suspension of nuclear testing." After first responding that testing was "one of the most complicated subjects that the government has to deal with," the President said that the U.S. stood by its offer to cease tests as a first step toward disarmament, as long plans included a proper inspection system "to make certain that the whole scheme was being carried out faithfully on both sides." Moreover, Eisenhower stood by the necessity of testing to develop cleaner weapons—a "clean" nuclear weapon would produce little to no radioactive fallout. He told the press that top scientists had informed him that then current bombs were 96% less dirty than the original bombs—that is to say, they produced 96% less radioactive fallout than had the original bombs—and that with enough time could be made completely clean (produce no radioactive fallout). This was important for two reasons. If a bomb were going to be used for peaceful matters, it would need to be completely clean. If used in war, a clean bomb would allow the U.S. military to confine the effects only to the desired target. Atomic bombs were destructive enough, and adding toxic radioactive fallout on top of the blast destruction seemed like a bad idea to U.S. decision makers.¹⁹ Eisenhower emphasized the importance of "clean" nuclear bombs for peaceful uses in a 3 July 1957 press conference when we said, "We are trying to make small bombs—clean bombs, and to develop

¹⁹ The President further elaborated on Soviet use of clean weapons, "I would hope that they would learn how to use clean bombs and if they ever used any atomic bombs would use clean ones, -- for the simple reason that then at least the bombs used would be specific weapons instead of weapons of general and uncontrolled destruction." DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 6, Press Conference 26 June 1957, Official White House Transcript of President Eisenhower's Press and Radio, Conference, #114, 2-5, 8.

usefulness in a peaceful world as well as just weapons of war.”²⁰ Of course, no guarantees existed that the Soviets would use clean bombs if they ever attacked the United States.

Behind the scenes, policymakers expressed similar concerns about nuclear fallout from atomic testing. At a meeting of the AEC Commissioners that same summer, Commissioner Willard F. Libby declared that, especially because of the disarmament talks occurring in London, it would be important to speed up the development of clean nuclear weapons.²¹ To that point, during the fall of 1957 the AEC and Department of Defense (DOD) planned a series of nuclear tests in April 1958 at the Eniwetok Pacific Proving Grounds. The draft public announcement of those tests stated, “The United States repeatedly has stated its willingness to suspend nuclear tests as part of a safeguarded disarmament agreement. Until such an agreement is attained, however, continued development of nuclear weapons is essential to the defense of the United States and of the Free World.” The AEC intended these tests to advance clean weapons “with greatly reduced fallout” and wanted to conduct the tests in a way that would “keep world radiation from rising to more than a small fraction of the levels that might be hazardous.”²² But no matter the push for disarmament and nuclear test cessation, some decision makers in the AEC thought the United States should continue testing.

²⁰ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 6, Press Conference 3 July 1957, Official White House Transcript of President Eisenhower’s Press and Radio Conference #115, 6.

²¹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 10, Meeting No. 1294, 17 July 1957, 335.

²² Underlining is present in the original document. DDEL, White House Office, Office of the Special Assistant, OCB Series, Administrative Subseries, Box 2, Folder Operations Coordinating Board General (3) [September-October 1957], Memo from R. Hirsche to Cutler, Subj: AEC Reaction re Hardtack (1958 Pacific Weapons Test) Announcement, 12 September 1957

Captain John H. Morse of the AEC, for example, repeatedly stressed the importance of testing for the United States, especially to help develop cleaner weapons. In a memo to F. M. Dearborn, Special Assistant to the President, Morse explained that the U.S. needed cleaner and smaller weapons than the country already possessed, declaring, “The true justifications for further testing may be divided into considerations of self interest, and moral, political, and military reasons.” The “self interest” reasoning related to the dangers of nuclear fallout. If nuclear war erupted without clean weapons, the damage from that fallout would be much more significant than from any tests the U.S. performed. Thus, even if the Soviets did not have clean weapons, the effects on worldwide radiation still were significant enough in a nuclear war that the U.S. should only use clean weapons. Morse also believed that smaller, cleaner weapons might reduce the chance of unlimited nuclear war. He continued, “Energy serves man to the extent he tames it. Nuclear explosives are no exception,” and further explained that test cessation “slams this door” shut at the moment when small nuclear bombs might be used just like dynamite.²³

Morse continued his reasoning by melding environmental and national security concerns, deeming nuclear weapons that produced little to no fallout vital to protecting the United States. For his “moral” reason, he claimed, “To overkill by radioactivity and excessive yield is immoral.” He also noted that a clean bomb could be made dirty if so desired, but vice-versa was not true—thus, a country with a clean stockpile would not lose the deterrence of dirty bombs, but would be able to fight clean if it so chose. To support his “political” reason, Morse argued that inadvertently but indiscriminately

²³ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 4, Folder Nuclear Energy Matters (2) [Jan 1958], Memo J. H. Morse to F. M. Dearborn, Subject: Reasons for Further Nuclear Testing, 20 January 1958, 1-2.

killing with dirty bombs—very likely in the case of nuclear war—might cause friendly or neutral nations to change their position on the United States. Morse’s “military” reason was that some targets, such as concrete runways or buried command centers, require larger blasts than can be achieved by conventional weapons. But unless such attacks used clean nuclear weapons, “Vast and deadly areas of nuclear contamination result,” which would be bad for both any invading military force or later occupying force. Morse finished by saying that agreeing to stop tests implied that testing was bad, and he thought this was not true at all. The United States should continue testing, as stopping would be to the “detriment of all mankind.”²⁴ Of course, not everyone agreed with Captain Morse’s reasoning.

Robert E. Matteson, Director of the White House Disarmament Staff, wrote a dissenting opinion back to Morse that questioned whether the United States needed cleaner weapons. Matteson reminded Morse that the latter previously had favored a two-and-a-half year test suspension. Morse had changed his mind, however, and now believed ground notification posts in the Soviet Union aimed at preventing surprise attacks would be more advantageous for the United States than the inspection posts involved in a test suspension treaty. Countering this logic, Matteson said that he did not believe the Soviets would accept installation of ground posts as a separate matter. Instead, Matteson declared that the original position from the National Security Council (NSC) Planning Board, installation of scientific instrument posts, seemed most likely to gain Soviet support. Moreover, Morse’s assertion that the U.S. needed cleaner weapons ignored that the weapons already were 95% clean, clean enough to confine much of the fallout of any

²⁴ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 4, Folder Nuclear Energy Matters (2) [Jan 1958], Memo J. H. Morse to F. M. Dearborn, Subject: Reasons for Further Nuclear Testing, 20 January 1958, 3-6.

nuclear attack over the Soviet Union. Moreover, Matteson was not convinced by Morse's "morality" reasoning, as the White House staff member questioned, "will morality have any real effect on what the Russians do or say?" As for the "military" reasoning, the Joint Chiefs of Staff had yet to offer any, and thus this point seemed less worthy.²⁵ In short, Matteson did not find Morse's arguments for why the United States needed to keep testing to be very convincing, especially if that reasoning might prevent a treaty with the Soviets.

A few weeks later, Dearborn condensed information in a memo to Eisenhower that argued for a policy based on balancing national security and environmental health. The President's special assistant asserted that the world needed to understand the value of continued U.S. nuclear testing, claiming that there were "real risks for mankind involved in test cessation." The memo continued that the nation should not accept the risks of ceasing tests lightly, and that if the country did decide in the end to "acquiesce," it should try to "force maximum concessions" from the Soviets or even try to "pass the onus to Russia as the nation willing to perpetuate existing deadly risks to mankind by opposing our attempts to control radioactivity. Thus Russia might appear the threat to humanity, not the U.S." In short, Dearborn believed, "test cessation [was] counter to the long-term welfare of mankind as well as national and free world security" because it posed a threat to efforts at developing cleaner bombs that reduced the amount of radioactive fallout any atomic detonation would spew into the atmosphere. He proposed that Eisenhower announce before the United Nations that, pending a nuclear weapons ban with inspection and disarmament, the United States would only produce clean weapons and only use

²⁵ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 4, Folder Nuclear Energy Matters (2) [Jan 1958], Memo Robert E. Matteson to John Morse, Subject: Test Suspension Issue, 24 January 1958, 1-6.

them for self defense, eliminate the danger of nuclear tests by testing them underground (or only testing clean versions), and also share clean nuclear weapon technology with the Soviets to “protect” humankind. Dearborn also included an attachment on “The Case of Clean Nuclear Weapons,” which was very similar to Morse’s original statement.²⁶ Of course, though this recommendation may have influenced Eisenhower, it did not end up becoming policy. Divided or not, Eisenhower administration officials continued down a path of negotiation and worked toward a test cessation treaty with the Soviet Union.

As historian Charles Maier pointed out, Eisenhower seemed much more willing to consider arms control in the latter years of his presidency (1958 and on) than he had earlier. Particularly, advances in Soviet missile technology influenced this opinion, as they made the idea of a costless massive retaliation infeasible.²⁷ Moreover, the Soviets also appeared quite willing to consider talks about a test ban, even if only on terms of their choosing. After conducting its own extensive test series in early March, on 31 March 1958 the Soviet Union announced that it would unilaterally cease all nuclear bomb tests, provided the United States and its allies also did the same. At this point, attempts to create some sort of nuclear test ban cessation agreement could begin in earnest. That is, test cessation talks could begin unless the United States kept testing and did not commit to the process. The choice was not easy, however, as Soviet actions had put the United States in a difficult position. While the Soviets had just finished a large test series, the United States had one planned for the near future. This put pressure on U.S. policymakers

²⁶ Captain John H. Morse was also sent a copy of the memo on the same day. DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 4, Folder Nuclear Energy Matters (4) [Feb-Mar 1958], Memo to President, 14 February 1958

²⁷ Charles S. Maier, “Introduction: Science, Politics, and Defense in the Eisenhower Era,” in *A Scientist at the White House: The Private Diary of President Eisenhower’s Special Assistant for Science and Technology*, by George B. Kistiakowsky (Cambridge: Harvard University Press, 1976), xxvi.

to decide what they thought was most important for the nation and its nuclear program. Questions abounded about what constituted the true threat to the world—real nuclear tests (with the goal to make cleaner weapons with less nuclear fallout) or potential nuclear war (that would surely contaminate the whole world).²⁸

AEC Chairman Lewis Strauss, for example, championed the idea that the U.S. should eschew the Soviet test ban offer and continue with its planned tests, generally arguing that making cleaner, less environmentally damaging bombs could function as an effective political tool for the United States. At the time, the United States still planned to conduct its Hardtack I series of tests starting in April 1958, but some worried that the “international atmosphere, with the Soviet initiative for a summit meeting and a cooling off of tensions, which has aroused wide favor does not make a favorable backdrop for initiating tests.” Strauss countered, “The testing of small clean weapons bordering on and blending into the conventional would serve to offset hitherto relatively successful Communist propaganda efforts to effect a distinct separation between conventional (good) and atomic (bad) weapons.”²⁹ Strauss thought reducing the fallout of U.S. weapons would take the venom out of some of the Soviets’ public relations attacks, and the United States could only do so through more nuclear tests. But the subject of continued testing was still open to some debate.

Following the unilateral Soviet declaration, the United States had several possible courses of action, but the overarching debate centered on whether or not nuclear testing should continue. Some in the AEC, especially Captain Morse, wanted to continue testing,

²⁸ Robert A. Divine, “Eisenhower, Dulles, and the Nuclear Test Ban Issue: Memorandum of a White House Conference, 24 March 1958.” *Diplomatic History*, Vol. 2, Iss. 1 (October 1978), 321-330.

²⁹ DDEL, White House Office, Office of the Special Assistant, OCB Series, Administrative Subseries, Box 1, Folder Chronological - Karl G. Harr January-March 1958 (4), Memo From R. V. Mrozinski to Staats, Subj: The Psychological Aspects of the forthcoming U.S. Nuclear Tests

but only underground (“thereby eliminating any spread throughout the world of radioactive material”). Others wanted to focus on further disarmament negotiations through United Nations channels. No matter the course of action, questions abounded. For example, if the U.S. suspended tests how long should that suspension last? There also existed a focus on using nuclear production for “non-weapons purposes” such as developing “‘nuclear dynamite’ for a variety of peaceful purposes.”³⁰ Policymakers did seem clear, however, that they needed to take action to ensure that the U.S. did not fall behind the Soviet Union in the global public relations arena, as if the Soviets stopped testing but the United States did not, the USSR could claim that the U.S. was not serious about making peace and instead continued to poison the atmosphere.

Others questioned whether the Soviets truly were serious in their desire for peace, pointing out that the USSR’s ban came at a very self-serving time immediately after it had heavily polluted the environment with its own nuclear testing. Senator Clifford Case (R-N), in an opinion mirrored by many in the executive branch, observed that the Soviet Union only suspended tests, unilaterally at that, after it had completed a long nuclear weapons test series, “described as putting into the atmosphere more radioactive material than ever before.” Case argued that the United States “must not let our enemies succeed in using the fear of poisoning the atmosphere—a fear felt increasingly by millions both in America and abroad—to halt our testing and development of weapons which may be essential to our very survival and to the protection of freedom everywhere on earth.” Since the United States had made great strides in the production of clean weapons, Case thought U.S. tests could continue and would not cause “a dangerous contamination of the

³⁰ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 5, Folder Nuclear Energy Matters (5) [Apr-Oct 1958], Memo for Mr. Staats by Manning H. Williams, Subj: Possible OCB Action on Disarmament, 1 April 1958

earth's atmosphere.”³¹ Concern for the environment and world political opinion, then, played a role in developing the U.S. position even at an early stage.

President Eisenhower was very clear on the issue of test cessation, however, and argued that the United States would not suspend tests, no matter how much they might harm the environment, if such a suspension would put the United States at risk. The President's pre-conference notes for his 9 April 1958 press conference declared, “The United States [sic] position is that we could not consider suspension of testing as a purely propaganda measure at the risk of the security of the nation.” Furthermore, the notes advised the President to stress that the United States would only stop testing when production stopped and inspections started. The U.S. also would continue Pacific tests.³² Once that press conference started, President Eisenhower fielded a question about the general ability to detect testing, as detection formed a crucial part of the country's position. That reporter asked whether “this problem has become more difficult in terms of negotiation” due to the notion that an increased number of detection and inspection stations were needed. Basically, for the sort of comprehensive ban the United States desired, when either side detected a potential nuclear test from a seismograph or atmospheric reading, that side would need to send in on-site inspection teams to verify whether the readings had detected a nuclear blast or merely some other natural phenomenon (frequently the two were difficult to distinguish). The President responded that the number of inspection stations then suggested by scientists was larger than it had

³¹ Remarks by Senator Clifford P. Case, Prepared for Delivery at Luncheon of Advertising Club of N.J. Honoring Secretary of Labor James P. Mitchell as New Jersey's Outstanding Citizen of 1957, Essex House, Newark, N.J. Noon, Wed., April 9, 1958. Sent to the White house in DDEL, White House Central Files, General File, Box 1216, Folder 155-B, Apr. – June 1958, Letter from Sam Zagoria to James C. Hagerty, 9 April 1958

³² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 7, Press Conference 9 April 1958, Pre-press Conference notes.

been previously, and that everyone needed patience to get a final answer.³³ The U.S. position held paramount the necessity of more technical and environmental knowledge to design any effective international treaty; hence the President proposed to organize a conference in Geneva that summer on the subject.

No matter how Eisenhower arrived at the position, however, his move to convene a Conference of Experts over the summer of 1958 returned positive public feedback, especially as the conference represented the first step to protecting the earth and its peoples. One Merritt S. Webster sent the President a letter congratulating him that the U.S. had moved toward test cessation, and declared, “May this really lead to less emphasis on weapons and stop the contamination of the atmosphere by manmade radioactivity.”³⁴ Another citizen exclaimed that stopping tests represented a “first great step toward maintaining a healthy environment for humanity and protecting the genetic heritage of untold generations to come.”³⁵ More than just normal citizens expressed their desire for an end to nuclear tests. One letter was signed by quite a few well-known figures, including Reverend Martin Luther King, Jr., Mrs. Franklin D. Roosevelt, and Christian ethicists Albert Schweitzer and Martin Niemöller. That letter told the President, “We want you to feel that your job is to help make this planet safe and fit for human

³³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 7, Press Conference 9 April 1958, Official White House Transcript of President Eisenhower’s Press and Radio Conference, #131, 4.

³⁴ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, July – Sept. 1958, Letter Merritt S. Webster to President, 24 August 1958

³⁵ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, July – Sept. 1958, Telegram Robert Sugerman to President, 29 August 1958 The idea that weapons tests, particularly the fallout of Strontium 90 from them, had already doomed thousands of children was widespread. Another letter from a U.S. citizen said, “My only regret is is [sic] this action was not taken years ago since already thousands of children are doomed to be born deformed as a result of tests in the past by our country, the USSR and Great Britain.” DDEL, White House Central Files, General File, Box 1216, Folder 155-B, July – Sept. 1958, Letter from Martin R. Haase to President

habitation.”³⁶ While the focus of this chapter certainly is not about public feedback on government policies, these reactions show that, like the President, at least a section of the public also cared about the environment and its relation to human health when considering nuclear testing. Encouragement from the public certainly would not have swayed Eisenhower’s opinion and might have helped cement it.

When the Conference of Experts finished, it released a report on 21 August 1958 that claimed covenanting nations would indeed be able monitor whether other signing nations faithfully followed the established guidelines through a series of on-site environmental monitoring stations. The Conference explained that tests on the Earth’s surface up to fifty kilometers high (thus not deep space tests) also could be monitored effectively. In response to this report, President Eisenhower announced the next day that the United States was willing to enter into nuclear test cessation negotiations with other world nuclear powers on 31 October 1958, provided those talks hinged on the establishment of an effective monitoring system. Eisenhower proclaimed the United States’ willingness to keep its test ban on a year-to-year basis, as long as an effective monitoring system stayed in place and the negotiation progress continued. The President also reminded his audience that such talks were only “significant” if they constituted the first step to world disarmament and the halt of fissionable material production.³⁷ On 25 October, Eisenhower issued another statement reaffirming his 22 August desire to suspend nuclear tests for a year and begin negotiations on 31 October. The United States’ sole condition for these talks required that the Soviet Union also suspend tests. The

³⁶ DDEL, White House Central Files, General File, Box 1216, Folder 155-B, Oct. – Dec. 1958, A Message to the Representatives of the United States, the Soviet Union and the United Kingdom Meeting to Negotiate an End to Nuclear Weapons Tests

³⁷ Eisenhower’s 22 August 1958 speech can be heard in its entirety here: <http://www.youtube.com/watch?v=qpZ4nDLvTdQ> Accessed 15 February 2012

President noted, “The United States regrets that the Soviet Union has not accepted the offer of the United States and the United Kingdom, although we still hope that it will do so.”³⁸ The Soviets shortly thereafter accepted the presented terms. Talks did indeed begin in Geneva on 31 October, with the convening nations beginning one-year test moratoriums around the same time.

The AEC Commissioners met on 1 December and discussed the “U.S. Position on Nuclear Test Suspension Negotiations,” grounding that position on a concern for the environments in which tests could be effectively monitored. The Commissioners’ general sentiment held that the Soviets scored a propaganda win with recent statements and that the U.S. “should develop a new position which would attempt to attain agreement to permit controlled underground testing but ban all nuclear weapons tests above ground.” Inspection systems remained important to the AEC, and the Commissioners believed there should be a temporary ban until such a system could be developed with an indefinite ban afterward. The Commissioners noted that Eisenhower’s 22 August statement “had specifically not included a reference to underground tests.”³⁹ This non-reference was important for two reasons. The first was that underground tests were nearly impossible to monitor, and the second is that the United States intended to continue nuclear tests underground, especially non-weapon nuclear tests.

Eisenhower released a statement on 7 November 1958 on the Soviet Union’s continuance of nuclear weapons testing, “despite the fact that negotiations for the suspension of testing of nuclear weapons have since October 31 been under way at

³⁸ DDEL, White House Central Files, Official File, Cross Reference Sheets, Box 88, Folder OF 108 Atomic Energy 1958, Statement by the President, 25 October 1958

³⁹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1422, 1 November 1958, 799-800.

Geneva.” The charge stated that the United States, on 22 August, had agreed to halt testing for a year provided the Soviet Union did as well. And though the USSR had stopped testing at its Arctic proving ground, the country had continued to test at another location, violating both this agreement and a United Nations General Assembly resolution that requested the negotiating parties not test during ongoing Geneva talks. The President continued, “This action by the Soviet Union relieves the United States from any obligation under its offer to suspend nuclear weapons tests. However, we shall continue suspension of such tests for the time being, and we understand that the United Kingdom will do likewise. We hope that the Soviet Union will also do so.” The President further elucidated the U.S. position by saying that if the Soviets did not shortly denounce testing, the U.S. would be “obliged to reconsider its position.”⁴⁰ Clearly the Geneva talks rested on the edge of a knife blade and could easily fall off at any time, no matter the willingness of one side or the other to formulate a treaty.

On 24 November 1958, the AEC Commissioners met specifically to discuss the nuclear test suspension talks and fleshed out the position already established, especially clarifying the necessity of a control system to any U.S. agreement. At this time, it became clear that the U.S. delegation had decided it did not want to link the test suspension talks to disarmament and held three basic positions: disarmament and test suspension should not be linked, periodic evaluations should be held to determine satisfactory progress of disarmament and control system implementation, and effective control systems were necessary to make sure testing actually stopped. The delegates considered yielding on the first two positions, but some in the meeting believed the U.S. should not yield on any

⁴⁰ DDEL, White House Central Files, Official File, Cross Reference Sheets, Box 88, Folder OF 108 Atomic Energy 1958, Statement by the President, 7 November 1958

fronts. The biggest point of contention rested on the notion of a control system for monitoring—the United States wanted one and the Soviet Union did not (odd in some ways, because during the Geneva Technical Discussions from June to August, the Soviets delegates had agreed on the need for a control system).⁴¹ Environmental science and geography proved central, as only by monitoring the natural world from specific locations could the United States feel comfortable about the authenticity of any test cessation treaty.

Importantly, out of distrust of the USSR, the Commissioners thought such a control system should not preclude U.S. entry into Soviet territory to inspect possible tests, as they deemed atmospheric monitoring alone insufficient to deter Soviet subterfuge—more environmental knowledge was needed to give U.S. decision makers the confidence to enter into a treaty. In the end, the Commissioners judged the U.S. position to be difficult because, since no test shots had been fired since 3 November 1958, a de facto test cessation agreement was currently in place with no control system. Moreover, the U.S. had to balance world opinion with legality, as public relations were crucial. The public held great fear of “off-site fallout,” though Captain Morse thought the public could be educated on fallout within a 2-3 year period. Eventually the Commissioners decided that the AEC should propose that the U.S. reject the recommendations of U.S. delegates and should not give into the Soviets at all.⁴² The AEC Commissioners met later that day to review the results of their earlier meeting and to propose using Christmas as an unofficial recess to negotiations. The meeting also

⁴¹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1432, 24 November 1958, 863-866.

⁴² NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1432, 24 November 1958, 866-868.

reviewed Captain Morse's previous position paper on the necessity of testing, but did not make any decisions based on it.⁴³ The AEC Commissioners held their next meeting on 2 December 1958, especially to discuss the test cessation talks and come to terms about how the AEC should proceed. Fundamentally, the Commissioners decided that the AEC was not fit to decide whether the Geneva talks should be about disarmament or not, but in the absence of disarmament the AEC should proceed with "armament development through testing, and testing would mean the need for controls."⁴⁴

That 2 December meeting also included a discussion of a test cessation proposal by Senator Albert Gore, Sr. (D-TN) that focused on protecting the earth from radioactive pollution produced by nuclear bomb tests. Gore proposed that Eisenhower "announce the unconditional and unilateral cessation of all nuclear tests in the earth's atmosphere for a specific period, possible three years, and ask similar action by other nuclear powers." This would keep treaty talks going and eventually might lead to discussions on the discontinuance of other types of tests. Gore's proposal stemmed specifically from him being "deeply concerned with the apparent impasse in the Geneva talks and with what he believed to be an increasingly high contamination of the atmosphere with radioactivity." Commissioner Willard F. Libby countered that the Soviet tests in October had raised strontium contamination in the Earth's atmosphere by twice what U.S. tests had during the previous four years. Since "the world cannot tolerate unlimited dissemination of airborne radioactivity," Libby believed "the President [ought to] make a public announcement concerning the amount of atmospheric radioactivity created during

⁴³ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1433, 24 November 1958, 869-871.

⁴⁴ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1434, 2 December 1958, 872-874.

October by the Russians.”⁴⁵ This sentiment shows that radioactive fallout in the atmosphere held great importance not only for how it damaged human health and the environment, but also for how it could be used by both sides to score political victories with the public.

The Commissioners saw several different positions the United States could take concerning Senator Gore’s proposition to stop testing for both political and environmental gains. The AEC could have supported Gore’s proposal or merely kept talks going at their present rate while ramping up U.S. aggressiveness at the negotiating table. Another possibility involved sharing (or not sharing) a technical paper with the Soviets that highlighted the costs of detecting underground tests (in contrast to effective and already existing means of detecting atmospheric tests) to prod the Soviets into agreeing to an atmospheric ban. The last choice called for Eisenhower to announce the airborne radiation previous Soviet tests produced and try to publicly shame the USSR into a bilateral agreement to stop further atmospheric contamination. Libby responded that the first two options were too negative and should not be undertaken, but that he liked the last two. Chairman McCone said that each of the latter choices could be interpreted as an attempt by the United States to break up the conference. Instead, he thought the U.S. should maintain its position that monitoring and controls were crucial for any agreement. Perhaps most importantly, Commissioner Harold S. Vance pointed out that the AEC had, the year previously, proposed to the President a plan similar to Gore’s. Eisenhower rejected that plan. Moreover, Foster believed that any announcement similar to what Senator Gore desired should be withheld until it was clear that the Soviet

⁴⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1434, 2 December 1958, 874-875.

delegates would not accept any control agreement.⁴⁶ Thus while the AEC took seriously the idea that nuclear tests poisoned the atmosphere, and by extension the whole planet and the human race, that idea held the most sway in how it could be used for political gains. While this may not be the sort of environmental consciousness most commonly thought of by modern environmentalists, it does demonstrate a developing sensitivity to the environment and a prioritization of environmental science by nuclear complex officials trying to balance their responsibilities to the nation as they understood these.

The meeting, as a whole, showed a melding of concerns about the nuclear complex, environment, national security, and politics, as decisions about one affected the others. As the discussion and meeting wound down, Brigadier General Starbird, Director of Military Application of the AEC, claimed “that the matters under discussion were highly sensitive in that if the Russians learned of the debating going on within U.S. Government agencies regarding the U.S. position at Geneva, they would be aware of a weakening in the U.S.-U.K. position and could exploit the situation.”⁴⁷ Distrust and paranoia aside, this meeting well laid out the AEC’s place in the negotiations. The Commission had no formal power in the talks, other than its advisory role on nuclear policy to the President. That said, nuclear test cessation was not necessarily in the best interests of the AEC as an organization. Contrary to what many historians have written, however, the AEC was not entirely against a nuclear test ban, even though a ban would have limited the agency’s power. Instead, the Commission balanced concerns about how tests affected the environment and human health, but did so within an institutional

⁴⁶ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1434, 2 December 1958, 875-877.

⁴⁷ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1434, 2 December 1958, 877.

framework obligated to develop the nuclear weapons deemed necessary for the security of the United States.⁴⁸

On 9 December, the Commissioners again met to discuss Senator Gore's test suspension proposal, particularly focusing on how detection capabilities differed vastly depending on environment. Following Gore's call for the Geneva conference to proceed immediately to negotiate for a permanent stoppage of atmospheric tests, Commissioner Libby pointed out that the number of stations required to detect atmospheric tests would be much fewer than those to detect underground tests. Atmospheric-only test detection stations could also be confined only to the Soviet Union, negating any possible issues of location in China, and would thus be both more geopolitically feasible and more economical. However, Chairman McCone chastised the AEC report made on Gore's proposal, as he felt the report only sought to discredit Gore's ideas and provided insufficient analysis. Moreover, Commissioner Vance reminded everyone at the meeting that with both President Eisenhower's 22 August announcement on halting U.S. weapons tests and the Geneva conference the United States hoped to achieve complete cessation of all nuclear tests. If the U.S. kept the negotiations from achieving that goal, the USSR

⁴⁸ Later on the same day, 2 December 1958, the AEC Commissioners reconvened for another meeting and again discussed nuclear weapons tests. Chairman McCone made three basic points: 1) whether disarmament was included in the treaty or not did not constitute an AEC decision; 2) not including disarmament meant an expected continuation of armament, meaning the improvement and development of weapons (this, of course, would continue to be under AEC control); 3) the AEC should reiterate its position from two weeks previously that disarmament is the treaty's basic purpose, and this should be in the preamble. McCone further stated that he would be satisfied with test suspension continuing indefinitely, so long as any agreement stayed linked to a detection network and any party could withdraw if the inspection program did not work. Fundamentally, the Commission agreed that any test cessation treaty would need as a requisite part some sort of detection system. Commissioner Vance pushed on this point, saying that if the USSR did not accept a control system, then the U.S. could say that it would not test without such a system, making it appear to the world that the Soviets were unwilling to accept controls. This might force the Soviet Union to admit to the world that they can only detect atmospheric tests, pressing them into a bilateral agreement on control of atmospheric tests, the United States' end goal. NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1435, 2 December 1958, 880-881.

might gain a propaganda advantage by stating that the U.S. had never been sincere about achieving a total ban. Chairman McCone countered that the United States should pursue the original goal of a complete ban, and if a more elaborate detection system was later found necessary that it could be considered at such a time.⁴⁹ Even if a partial ban might have been much more feasible in the moment and eventually have led to a complete ban, there clearly existed a significant section in the AEC's leadership that thought the United States should pursue a total ban or no ban at all.

The issue of a control system continued to vex negotiators, especially because detection capabilities differed in each testing environment. Even from the beginning of the atomic age, issues of test detection existed, and the very first Soviet test heightened their importance. Almost a decade previously, on 3 September 1949, the United States began detecting "the emission of large quantities of radioactive material" and later determined through various systems that this came from the first Soviet atomic test.⁵⁰ A year later, the U.S. public learned exactly how this occurred. On New Years Eve of 1950, brothers Joseph and Stewart Alsop (two men very unpopular with the Truman administration for not toeing the official line at all times) wrote an article for the *Washington Post* titled "How Red A-Blast Was Detected." The article rankled many, especially Gordon Dean, AEC Chairman, who declared that detection methods represented "a tightly held secret" that he did not appreciate the Alsop brothers divulging. President Truman himself called the article "a matter of deep concern [because] of its disclosure of highly classified information of major significance to our national

⁴⁹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1440, 9 December 1958, 909-911.

⁵⁰ HSTL, Papers of Truman, President's Secretary's Files, Box 174, Folder Atomic Bomb Reports, U. S. Weather Bureau Report on Alert Number 122 of the Atomic Detection System, 29 September 1949, 1.

security.”⁵¹ National security or not, the *Post* article clearly explained the U.S. method for detecting blasts.

The detection system had four parts, and all of them depended taking measurements of the natural world and interpreting those readings: seismic readings, using Geiger counters to detect the presence of radioactive particles in the stratosphere, sampling air particles from the radioactive cloud, and finally having scientists interpret all the data. The Alsops explained, “When the Soviet bomb exploded in central Siberia in September, 1949, all this elaborate organization, already trial-tested by our own Eniwetok bomb, went smoothly to work.” Seismologists located the explosion location and Geiger counters detected the radioactive cloud, with air samples providing the “decisive evidence” of the bomb detonation occurring and its type, as different nuclear processes (ex. uranium bomb vs. plutonium bomb vs. an atomic pile explosion) produced very different sorts of radioactive particles.⁵² And yet for all the desired secrecy on test detection systems during the Truman presidency, by the summer of 1958 things had changed a great deal. The July 1958 semiannual AEC report to Congress contained an appendix titled, “Information on Detonations Released For Use In Seismological Studies.” Though it left out some important information, such as power of the tests, the appendix released exactly when and where U.S. tests happened and what type of test occurred so that seismologists could cross-reference their records with the AEC data.⁵³ Released at the same time as the Conference of Experts occurring that same summer, the AEC surely intended the data to further test cessation talks and make discussions of a

⁵¹ HSTL, Papers of Truman, President’s Secretary’s Files, Box 176, Folder Atomic Energy, Superbomb Data, Memo from President to Attorney General, 4 January 1951

⁵² Joseph and Stewart Alsop, “How Red A-Blast Was Detected,” *The Washington Post*, 31 December 1950

⁵³ *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 394.

monitoring network much more feasible. Such an appendix especially demonstrated several things—not only was the United States very serious about establishing a control system to aid test cessation talks, but decision makers understood that environmental knowledge was key to that process.

The AEC Commissioners met on 22 December 1958 and discussed the proposed AEC position on test cessation, and unsurprisingly the issue of a control system loomed large over the proceedings. With the Geneva talks on a break surrounding Christmas, the AEC revised its official position for when talks resumed in January 1959 so that the AEC would suggest no arrangements be made on a control system until its scope could be determined. The Commission would also stand by the idea that fixed detection posts would be inadequate because the Soviets might just find a way to work around any immovable posts. The issue of whether stations were needed in China remained tricky, and General Starbird stated that he felt not including posts there would create a possible loophole. The issue elicited a lengthy discussion, but no clear answers.⁵⁴ What remained clear, however, was that while knowledge of the environment allowed for test detection under certain circumstances, similar knowledge also aided any country that desired to test nuclear weapons without the knowledge of rival nations. Whether a country desired to construct a control system or evade it, understanding the natural world proved vital in such efforts.

The next day, Harold Vance, as acting AEC Chairman, sent a memo to summarize the AEC position on detection systems to Under Secretary of State Christian A. Herter, and that AEC position drew heavily from environmental science. Vance told Herter that

⁵⁴ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1448, 22 December 1958, 993-995.

seismological results from the underground nuclear tests conducted in Nevada in October 1958 showed that the Conference of Experts' conclusions on detection "require re-examination." In short, the detection capabilities assumed during the conference were not as accurate as initially believed. Therefore, the AEC proposed the U.S. adopt a new position because of three reasons. First, the control system proposed by the Conference of Experts to detect underground and space explosions had a much more limited capability than initially believed. Also, tests in those environments did not cause fallout like atmospheric tests, meaning preventing tests underground and in outer space proved less pressing to world concerns than atmospheric tests. Moreover, extremely adequate control systems already existed for atmospheric testing and thus the United States would not have to sacrifice its core stance on detection to ban atmospheric tests. The new proposed AEC position was that the U.S. should adhere to the idea that only detectable and identifiable tests should be stopped and negotiate, as a first step, a treaty for the cessation of atmospheric tests. The United States also should postpone treaties about underground and space tests, while proposing international cooperation in investigating identification problems and preserving the right to develop "non-military applications of nuclear explosives."⁵⁵ The implication was that tests might eventually be banned in all environs, but only when environmental knowledge advanced enough to allow for detection measures deemed adequate by the United States.

This official AEC position, suggested as a model for the U.S. negotiators, reinforced the importance of environmental factors and test detection capabilities to any test cessation agreement. Moreover, the Commission emphasized that stopping

⁵⁵ DDEL, John A. McCone Papers, Box 6, Folder Testing File #1 Eyes Only (3), Letter from H. S. Vance to Christian A. Herter, 23 December 1958

atmospheric tests should be the primary goal anyway, as these tests are the ones that cause radioactive fallout and damage the environment and in turn human health. Thus the environment, long before negotiators had even decided what the official goal of their talks was, played a crucial role. Not only did concern for environmental health form a significant part of the reason for the talks, but also examining the environment (both the atmosphere and with seismological readings) was the only way to tell if a nuclear test had occurred. It is unclear whether participants at any level, including in the AEC, recognized that the Earth and its systems were a significant actor in test cessation negotiations, but the planet certainly was. Moreover, knowledge (or lack of knowledge) about how the Earth functioned played a paramount role in determining the U.S. position.

Yet the AEC had not settled on an official position, as differing goals between U.S. officials made it difficult to achieve consensus about how to put existing environmental knowledge into practical use. On 26 January 1959, Chairman McCone met with the other Commissioners to firm up the AEC's position on test cessation so that McCone might be prepared for later meetings with the Secretary of State and Department of Defense. Fundamentally, the issue of a detection system loomed large. The Commissioners—those with military and civilian backgrounds alike—all agreed that the AEC needed more underground testing to gain the necessary environmental knowledge to develop an adequate detection system. Commissioner Graham suggested the U.S. “develop an orderly program for obtaining the additional information needed for establishment of an adequate detection program” and should do so immediately, not reserved as a fallback position. He did believe all atmospheric tests should stop. Commissioner Vance pointed out that top U.S. scientists agreed that the inspection

system approved during the summer 1958 Geneva Conference of Experts was not adequate, and agreed with Graham's position that the U.S. needed to conduct more underground tests "to know with certainty that a detection system would be dependable," though the earliest time more underground tests could be conducted was summer 1959.⁵⁶

Practically, though, the Geneva talks could not wait on these tests so the AEC needed to take existing environmental knowledge about the nuclear complex and form a new base position immediately. After further discussion, the Commissioners decided on several recommendations. First, the U.S. proposal should seek agreement among nuclear powers to suspend atmospheric tests and create "an adequate detection system to insure compliance. This step would eliminate the fallout issue." Second, the U.S. proposal should permit testing in outer space and underground "pending the conclusion of a series of tests in diverse geographical and geological environments and in outer space from which could be designed an effective system to detect and identify such explosions" Such tests could be joint efforts or unilateral, and the data would be shared either way.⁵⁷ More discussions continued on how measuring the Earth could help detect nuclear weapons tests.

By the end of March 1959, the U.S. Department of State-sponsored Panel on Seismic Improvement reported its findings, but the fact that the Panel even came into existence is a testament to the need and desire for improved environmental knowledge to aid in the improvement of detection systems. The report's message can be summed up by its title, "The Need for Fundamental Research in Seismology." The Panel explained that

⁵⁶ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1459, 26 January 1959, 75-76.

⁵⁷ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1459, 26 January 1959, 76-78.

both earthquakes and nuclear explosions produce seismic waves, and therefore determining the difference between the two from a seismograph represented the key issue. To have such a capability, however, would require greater knowledge about seismic waves. The Panel concluded, “The strategic requirements of detection, together with the need to maintain a competitive position in one of the most significant fields in the earth sciences make it a matter of urgency to institute a high level of support of seismological research.” The report also laid out exactly the sort of research the panel thought should be conducted.⁵⁸

Decision makers created the Panel to consider “the feasibility of improving the capability of the system recommended by the Geneva Conference of Experts last summer to detect and identify underground events.” To do so, the panel looked at ways to improve the Geneva system with existing technology, improve the system through research in seismology, and the possibility that any detection system might be circumvented via concealment of underground tests. The Panel also confirmed that earlier detection methods did not work as effectively as previously thought and validated concerns about the difficulty in distinguishing from seismic readings alone whether a tremor had been from an earthquake or a nuclear detonation. Improved equipment and techniques would greatly improve detection capabilities for underground shots, but detection still would be limited to blasts no smaller than five-kiloton weapons. And yet, these conclusions came from still very limited data, and “The Panel concluded that a vigorous research program in seismology would result in important improvements in the ability to detect and identify earthquakes of small magnitude.” It also suggested that

⁵⁸ DDEL, John A. McCone Papers, Box 6, Folder Testing File #1 Eyes Only (1), The Need for Fundamental Research in Seismology: Report of the Panel on Seismic Improvement, 31 March 1959, 1-2.

augmenting the Geneva net with unmanned stations also might improve capabilities.⁵⁹

The Panel's report and even its very creation help emphasize the importance of the natural world in any test detection system. Without both environmental measurements and improved knowledge to help interpret such readings, creating an effective control system would be all but an impossibility. Without that control system, the United States never would agree to any test cessation treaty. In effect, the United States fundamentally required high-level understandings of the natural world to proceed with any treaty talks aimed at ending nuclear weapon tests.

Two weeks after the Panel on Seismic Improvement released its report, President Eisenhower wrote a public letter to Soviet Premier Nikita Khrushchev on the subject of the test cessation talks, and, unsurprisingly, the issue of a detection system and how it might influence the eventual treaty took up much of the ink. Eisenhower declared that the United States "strongly seeks a lasting agreement" about test cessation, but that the agreement should be "subject to fully effective safeguards" and the "present proposals [by] the Soviet Union fall short of providing assurance of the type of effective control in which all parties can have confidence: therefore, no basis for agreement is now in sight." And yet, the President asserted that the cessation talks "must not be permitted completely to fail." Thus he thought perhaps talks should start only with an atmospheric ban, because such tests could be monitored and would not require on-site inspections. Continuing the use of fears about radioactive fallout for political gain, Eisenhower asserted that some sort of test ban was vital to calm the public about atmospheric radiation. Doing so would cause "fears of unrestricted resumption of nuclear weapons testing with attendant

⁵⁹ DDEL, John A. McCone Papers, Box 6, Folder Testing File #1 Eyes Only (1), Findings of the Panel on Seismic Improvement, 1-4.

additions to levels of radioactivity [to] be allayed, and we would be gaining practical experience and confidence in the operation of an international control system.”⁶⁰

Ten days later on 23 April 1959, Khrushchev responded to Eisenhower, also in a public letter, and questioned some of Eisenhower’s basic assumptions about testing and the natural world. Khrushchev said he was glad that Eisenhower also was “of the opinion that these negotiations must not be allowed to fail.” Yet, Khrushchev argued that stopping atmospheric explosions up to fifty kilometers did not “solve the problem,” nor did it prevent the production and improvement of other types of nuclear weapons. He continued, “explosions of nuclear weapons at altitudes of more than 50 kilometers would also poison the atmosphere and the earth, contaminating with radioactive fallout the vegetation which finds its way into the food of animals and into the human organism, just as is occurring at the present time.” Even though detection might stop at fifty kilometers, detonations at both forty and sixty kilometers similarly affect the atmosphere and human health meaning that a ban on tests only fifty kilometers and below represented a “dishonest deal.” The Soviet Premier thought that such issues should not deter either side and the talks must find a way to cease test of all types of nuclear weapons. Khrushchev acknowledged that the “most serious difference” between the U.S. and Soviet positions was the issue of inspection teams, but that no matter what the talks decided, the Soviets would “make every effort to achieve agreement on the cessation of nuclear weapons tests,” telling Eisenhower that he could “be certain that if we sign a document we shall, even if there is no control whatsoever, faithfully carry out the obligations assumed by us, because for the Soviet Union public opinion and the opinion of nations is dearer than

⁶⁰ DDEL, John A. McCone Papers, Box 6, Folder, Test File - March 1960, Letter Eisenhower to Khrushchev, 13 April 1959

anything else.”⁶¹ No matter that both sides were attuned to environmental understandings and espoused platitudes about how tests “poison the atmosphere and the earth,” differences continued unresolved.

In May 1959, the AEC Commissioners met and received a presentation on potential treaty control systems by Sterling Colgate, advisor to the U.S. delegation to the Geneva test cessation talks. Colgate discussed the Soviet position on the talks and summed up his ideas in six points. He claimed that the USSR would not insist on veto rights over each proposed inspection of a suspected nuclear detonation as long as there was a maximum number of yearly inspections, had accepted that technological criteria will be used to dispatch inspection teams, would not object to establishment of permanent inspection teams, would insist all inspection teams contain Soviet nationals, would agree to inspection teams having on-site inspection access, and that the number of inspections each year must be limited, though that number was a political question and subject to negotiation. The Soviets also suggested they might forego veto power for other questions as well, but that the U.S. delegates had not explored such positions as they awaited further instruction from Washington.⁶²

Still, the issue of test detection remained the stickiest wicket in the treaty talks. The Commissioners met again on both 8 May and 12 May 1959 and discussed the Geneva Conference. In the latter meeting, the Commissioners learned that talks would adjourn until the week of 8 June and that the Soviets had agreed to a proposed control

⁶¹ DDEL, John A. McCone Papers, Box 6, Folder, Test File - March 1960, Letter Khrushchev to Eisenhower, 23 April 1959

⁶² NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1500, 1 May 1959, 294-295.

system that would use satellites to observe nuclear tests in outer space.⁶³ After talks had resumed, a reporter questioned President Eisenhower about the idea of “decoupling,” or using specific techniques in underground atomic tests so that tests appeared much smaller than they actually were. For example, the seismic readings from a ten-kiloton blast might measure as the equivalent readings from a one-kiloton test. The President responded that while concealment techniques had improved, so had detection techniques, and therefore detection capabilities were roughly the same as earlier, despite technological improvements.⁶⁴ The improvement of environmental knowledge may have enabled improved detection capabilities, but it also provided any countries determined to avoid detection the means to do so, emphasizing how scientific knowledge and technological advancements play no favorites and can be used by different parties for different aims.

Over that same summer, AEC Chairman John McCone went to Geneva to attend the Conference on Nuclear Test Cessation, and his time there showed him that the issue of a detection system mired the talks to an even greater degree than he had thought. After his return on 2 July, he gave the AEC Commissioners a report on his trip. McCone described a dinner he attended “as a pleasant and convivial affair at which there was a frank exchange of views among those present,” and yet in spite of the amiable conversations problems still existed. For starters, the Soviets insisted that they would not agree on a specific quota about on-site inspections until both sides reached an agreement “on the idea of a quota.” McCone feared that there was pressure to reach an agreement on

⁶³ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1505, 8 May 1959, 316. NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1506, 12 May 1959, 319-320.

⁶⁴ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 8, Press Conference 17 June 1959, Official White House Transcript of President Eisenhower’s Press and Radio Conference, #161, 3-4.

a quota with no reference to the technical capability of the supposed inspection system, and he was afraid that if that happened public opinion might cause the United States to accept an inadequate number, such as twenty-five inspections per year or less. Moreover, while the United States did not desire a ban on anything that could not be monitored, the Soviets still pushed for a complete ban.⁶⁵ The fact that the two sides could not even agree “on the idea of a quota” is a bit shocking considering how long the talks had been going, but the melding of international politics and environment has rarely, if ever, produced easy answers.

Prompted by these fundamental differences between U.S. and USSR positions, McCone said the congressional consensus recently expressed to him had been that the Conference should be recessed so that “senior Government people capable of making an objective appraisal” could reexamine the U.S. position. Only then could the United States develop a firm stance, and upon the Conference’s reconvention the U.S. delegates should state this position (esp. on basic issues of inspection, staff access, and veto) and force an agreement before returning to fringe issues. And yet, U.S. scientific advisors could not decide on the technical components of some of these issues. In June, Chairman McCone had noted a planned scientific panel to evaluate test detection systems. This “Interdepartmental Panel on Test Detection” contained representatives not only from the AEC and White House, but also the Department of Defense, Central Intelligence Agency, and the State Department. But as of early July, there existed no set agreement by the Interdepartmental Panel on the number of required inspections for an adequate control system, and General Starbird contended that even more important than technical

⁶⁵ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1526, 2 July 1959, 436-437.

requirements was the unknown role that U.S. intelligence reports might play in verifying any test ban violation.⁶⁶

In August, President Eisenhower extended the one-year nuclear test suspension until 31 December 1959 in an attempt to salvage the talks, which became less and less likely as time passed. This prompted the Soviet Union to state that it would not resume its own nuclear tests so long as the U.S. and its allies maintained their moratorium, but by December, it became clear that an agreement likely would not be reached before 1 January 1960. In October, General Starbird wrote a memo that the U.S. should plan to begin testing underground as soon as possible after the 1 January deadline.⁶⁷ In one December meeting, AEC Chairman McCone announced that the Congressional Joint Committee on Atomic Energy (JCAE) supported the AEC's position on the necessity of effective monitoring in any test ban agreement. Since it seemed unlikely any agreement would come to fruition before the year's end, Senator Clinton P. Anderson (D-NM), chairman of the JCAE, "urged" that the AEC be in a position to test nuclear devices as soon as the test moratorium ended.⁶⁸ The U.S. position continuously evolved, though, at least in its details.

Less than a week later, the Commissioners met again and discussed the idea of a "phased suspension treaty" where the test ban might initially extend up into the atmosphere to 300,000 kilometers (around 186,000 miles). A ban to this height should have eliminated any fallout problems and could be monitored with a combination of both

⁶⁶ On the first mention of the Interdepartmental Panel on Test Detection: NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 12, Meeting No. 1521, 19 June 1959. On all else: NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1526, 2 July 1959, 437-439.

⁶⁷ DDEL, John A. McCone Papers, Box 6, Folder Testing File #2 Eyes Only (2), Memo Alfred D. Starbird to McCone, subj: AEC Position Relative to Testing, 26 October 1959

⁶⁸ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1572, 11 December 1959, 663.

ground controls and satellite systems.⁶⁹ Thus reducing atmospheric pollution remained important, but geopolitical strategic concerns trumped environmental and health concerns in the long run. An underground test ban remained off the table for the United States, though on 18 December in Louisiana the AEC performed two high explosive detonations as part of an experiment on decoupling atomic tests (making underground blasts appear much smaller than they are).⁷⁰

The AEC report to Congress on the year 1959 well summarized the previous year's activity, and its simple timeline of events helped show that environmental health and knowledge lay at the center of the talks. After the Conference of Experts met in Geneva from 1 July to 22 August 1958, negotiations began on Halloween of 1958 and were ongoing. A second technical conference had met for a few weeks during summer 1959 and produced a report that described a system of monitoring nuclear detonations at very high altitudes and in outer space. And yet, as the year closed, no real agreement existed, other than a "Memorandum of Cooperation," signed 24 November 1959, that provided for reciprocal information and scientific exchanges.⁷¹ The negotiating countries still could not agree on some of the basic goals of talks, such as exactly what sorts of tests would be banned, indicative of differing goals based on the way disparate environments affected test detection capabilities.

On 11 February 1960, President Eisenhower released a statement on the state of the test cessation negotiations, but even though he declared that the U.S. would start pushing a proposal to end the negotiation deadlock, his statement accentuated U.S.

⁶⁹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1573, 15 December 1959, 676.

⁷⁰ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1575, 19 December 1959, 692.

⁷¹ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 97-100.

intransigence on the issue of a detection system. The President reminded the public that the United States “had stood, throughout, for complete abolition of weapons testing subject only to the attainment of agreed and adequate methods of inspection and control.” Following this position and foreshadowing the treaty eventually penned in 1963, the U.S. proposal would seek to end tests “in all the environments that can now be effectively controlled”—tests in the atmosphere, oceans, space, and underground where it could be monitored. While not a complete test ban, the proposal contained “initial, far-reaching, but readily attainable steps” that would “allay world-wide concern over possible increases in levels of [...] radioactivity into the atmosphere.”⁷² Such a treaty proposal looked remarkably similar to the eventual 1963 Limited Test Ban Treaty and highlighted that the fundamental environmental issues at hand (reducing radioactive fallout from the atmosphere and navigating the differing environmental responses produced by nuclear testing).

Several days later, expecting questions on the new U.S. position, a briefing paper for Eisenhower’s 17 February press conference gave the President some prepared answers that unsurprisingly cast the United States in the best possible light while concomitantly seeking to put all blame for treaty talks on USSR diplomats. The Soviets had turned down the U.S. proposal and countered with their own plan that would ban all explosions, but only allow a limited number of inspections on suspected programs or explosions. The briefing sheet told Eisenhower that the correct “answer” was that such a policy “casts considerable doubt on the Soviet Union’s professed desire to halt nuclear weapons tests,” and that the Soviets are doing a “disservice” to “the hopes of all peace

⁷² DDEL, John A. McCone Papers, Box 6, Folder, Test File - March 1960, Statement by the President, 11 February 1960

loving people.”⁷³ When asked about this in the actual press conference, the President reviewed the situation and then stated that he thought the U.S. proposal had been a good one, and that the Soviets’ counter-proposal seemed to change the criteria they were willing to observe. Hence deciding on an appropriate number of inspections would be difficult.⁷⁴ Even when the two sides seemed closer to reaching an agreement, significant, fundamental differences in positions remained.

The issue of detection systems continued to vex negotiations as increasing environmental knowledge both allowed for greater test detection and highlighted the ever-increasing difficulty of detecting the covert tests of any potential treaty violators. The briefing paper for President Eisenhower’s 27 April press conference informed him that scientists claimed a need for 180 more testing stations in order to ensure effective monitoring. This would help the U.S. achieve a system to monitor a ban on “all nuclear weapons tests in the atmosphere, the oceans, at high altitudes and above seismic magnitude 4.75 in the underground area.”⁷⁵ At the actual press conference, a reporter questioned the President about testimony the previous week before the JCAE on how “the art of concealing underground tests was outstripping the art of detecting them.” The President replied that the U.S. position only concerned itself with tests that produced seismic readings of 4.75 or more, which Eisenhower said would come from bombs

⁷³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 17 February 1960, Briefing Paper, 1-2.

⁷⁴ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 17 February 1960, Official White House Transcript of President Eisenhower’s Press and Radio Conference, #181, 7.

⁷⁵ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 27 April 1960, Briefing Paper, 1.

somewhere around the twenty-kiloton range. Anything below that would require a separate plan.⁷⁶

No matter the progress made (or not made), after 1 May 1960 the possibility that any agreement might be reached on a test cessation treaty diminished greatly, at least in the minds of the participating parties.⁷⁷ On that day, Soviet forces shot down a top secret U.S. U-2 spy plane, piloted by Francis Gary Powers. Since 1956, U-2 missions had gathered information, snapped photographs, and provided the United States important intelligence on the Soviet Union that it otherwise never would have had. At first, the U.S. position on the shot down plane followed a predetermined cover story that the aircraft was a low performance, high-altitude weather research plane. Soviet Premier Khrushchey, over the course of two weeks, slowly released information to the world public that showed this story to be false and proved the U.S. statements to be prevarications. Once the USSR revealed that it had the pilot, Francis Gary Powers, in custody, the U.S. could no longer deny the U-2's true purpose. Higher-ups had instructed Powers to kill himself if captured to avoid any such incidents, but in the moment, as scientific advisor to the president George Kistiakowsky put it, "he just chickened out." Kistiakowsky explained the incident simply: "the affair affected the whole tone of the administration."⁷⁸

⁷⁶ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 27 April 1960, Official White House Transcript of President Eisenhower's Press and Radio Conference, #184, 9.

⁷⁷ Per Fredrik Ilsaas Pharo, in his article "A Precondition for Peace," argued that the U-2 affair had little to do with a treaty never coalescing during the Eisenhower presidency, instead arguing that constant elements in the U.S. government (and thus not external events) constituted the most important factors.

⁷⁸ George B. Kistiakowsky, *A Scientist at the White House: The Private Diary of President Eisenhower's Special Assistant for Science and Technology* (Cambridge: Harvard University Press, 1976), 312-314, 321-322, 324.

In the days after the Soviets shot down the U-2 plane, at first U.S. administrators acted as if everything would be fine. On 3 May, the AEC Commissioners met to discuss the U.S. position on how many inspections should be permitted in the USSR under a test cessation agreement. In short, the minutes noted that a “re-evaluation of the proper threshold for detection together with further study of the relationship between on-site inspections and the pattern and number of inspection stations within the USSR [had] presented new problems.” Other issues included how and what type of monitoring system would be used (a new system installed or already existing stations used) and what would happen to the information as the stations collected it. The President had previously approved a U.S. position for twenty on-site inspections each year and a system that monitored for seismic activity above 4.75 on the Richter scale. On-site inspections could be fly-overs, follow-up ground inspections, or drilling operations. Of course, new data from the RAND Corporation indicated that increased control stations might mean that on-site inspections could be decreased, but some maintained a position that the U.S. should propose a high number of on-site inspections so as to have something to give up in negotiations. On-site inspections could have cost up to \$6.5 million a year.⁷⁹

By 11 May, the United States seemed to be abandoning the possibility that a test cessation treaty could be accomplished during the Eisenhower administration, as the U-2 affair overrode any environmental or security concerns that might push toward an agreement. In preparation for a press conference on that day, the President received a briefing paper that counseled him how to answer questions about a recent U.S. announcement to resume tests. Eisenhower was supposed to respond that this

⁷⁹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1616, 3 May 1960, 320-323.

announcement had been misunderstood, and that these tests were purely so that the U.S. could “further an improved capability to detect and identify underground nuclear explosions.” Moreover, the tests did not represent anything new, just the ramping up of an already existing program.⁸⁰ No matter the justification, nuclear tests of any sort would have made negotiating a nuclear test cessation treaty extremely difficult.

Furthermore, advocates for more nuclear tests remained in positions of power, particularly in the military, and where diplomats might have worried about public reaction to increasing atmospheric radiation, military men proved more concerned with more direct national security issues. In June, Nathan F. Twining, chairman of the Joint Chiefs of Staff, sent a memo to Secretary of Defense Thomas F. Gates on the subject, “Draft Treaty on the Discontinuance of Nuclear Weapons Tests.” In that letter, Twining explained that the Joint Chiefs’ position held “that an adequate military posture for the United States will not be attained until there is available a complete spectrum of weapons compatible with modern delivery systems which will make it possible to apply selectively adequate force against any threat.” A test ban would not allow the U.S. to develop that spectrum of nuclear bombs. And even though the Joint Chiefs recognized that stopping tests could indefinitely maintain the nuclear arsenal advantage the United States held over the Sino-Soviet stockpile, only a treaty complete with adequate safeguards would do so. Fundamentally, though, the Joint Chiefs believed that detonating nuclear weapons as tests

⁸⁰ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 11 May 1960, Briefing Paper

played an “essential” part in maintaining nuclear deterrence and national security should be the most important factor.⁸¹

Even without a feasible treaty in the near future, the United States continued to work toward a time when an agreement might be possible with environmental research programs. The AEC Commissioners met early July to discuss a proposal for a “Seismic Research Program.” Devoting their entire 1 July meeting to the subject, AEC Chairman McCone reported that after a 30 June 1960 “meeting of the Principals, a new proposal for the seismic research program” existed. Policymakers grounded the program in a control method of pooling devices between the U.S., UK, and USSR, with each nation sharing designs with the other two nations. In yet another instance of amalgamating geopolitical security and environmental concerns, significant issues existed with such a program, especially over whether Soviet nuclear devices might be used on U.S. soil within the testing program and whether certain tests constituted weapons tests or not. Finally the Commissioners decided “that too much detail should be avoided in presenting the statement initially [to the Soviets], and that further details could be more advantageously determined after initial Soviet reactions.”⁸² Several days later the Commissioners again focused an entire meeting on the seismic research program. Particularly important to those at the meeting seemed to be disassociating the Plowshare program for peaceful uses of atomic weapons from the seismic research program.⁸³ Issues of a control system continued to dominate the U.S. position.

⁸¹ DDEL, John A. McCone Papers, Box 4, Folder RES&D 1-2 -- TESTING -- March 1960 - July 1960 [Folder 1] (1), Memo From N. F. Twining To Secretary of Defense, 13 June 1960, subj: Draft Treaty on the Discontinuance of Nuclear Weapons Tests

⁸² NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1634, 1 July 1960, 491-497.

⁸³ NACP, 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1636, 6 July 1960, 502-505. Project Plowshare attempted to use nuclear

A late July 1960 position paper on the issue of nuclear test detection at high altitudes provides another example of how test detection and environmental knowledge and measurements governed U.S. thinking on the issue. Previous evaluations noted that a high altitude detection system could be installed in about two years, but would depend on unproven techniques and instrumentation. Moreover, any “determined violator” could evade any potential control system with existing technology. This caused the U.S. Defense Department to recommend that the nation limit its treaty obligation only up to tests in the top of the stratosphere (30-50 km, or the detectable portion of the atmosphere) with research done on any higher altitudes. The State Department, however, did not agree with this position. Either way, detection techniques would have to be improved constantly to stay ahead of evaders, as U.S. ideas of a ban still fundamentally depended on effective controls. The position paper explained that any treaty based on “unproven technique would be inconsistent with our basic principle.” Eventually, the paper recommended that the Defense Department take the following positions: limit test bans to environments where they could be detected, propose a moratorium of no more than two years, separate from the treaty at hand, on banning outer space nuclear tests, and the

weapons during times of peace as a sort of nuclear dynamite. Just as dynamite might be used for mining, road construction, or demolition, nuclear “dynamite” could possibly help excavate harbors or move mountains. Preliminary studies into peaceful uses of nuclear explosives showed that “certain engineering and industrial projects not economical or practical with conventional explosives might be accomplished with nuclear detonations.” These included “mining and civil engineering applications.” DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 5, Folder Nuclear Energy Matters (5) [Apr-Oct 1958], Memorandum for the Operations Coordinating Board, Subj: Item for Luncheon Meeting, 8 October 1958 For more on the Plowshare program, see: Dan O’Neill, *The Firecracker Boys* (New York: St. Martin’s Press, 1994); Scott Kirsch, *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving* (New Brunswick: Rutgers University Press, 2005)

Department of Defense should defer tabling the outer space ban until more negotiating could be done “concerning the coordinated seismic research program.”⁸⁴

An August 1960 article in the *Atlantic* by Dr. Hans Bethe, Nobel laureate in physics, titled “The Case for Ending Nuclear Tests,” summed up the events to date, focusing especially on the issues of test detection and how nuclear tests affected the natural world. Bethe told his readers that the issue of nuclear test cessation frequently turned into an issue of detection, and while blasts could be detected fairly easily in the air and very easily underwater, it was quite difficult to detect blasts in outer space. Underground testing was also difficult to detect and had thus received the most publicity. Bethe explained, “It has the obvious advantage that it does not contaminate the atmosphere, and therefore the great disadvantage, from a detection point of view, that radioactive air samples cannot be gathered.” U.S. tests in Nevada had shown that, if buried deep enough (about 400 feet for a 1 kiloton blast, or about 1,100 feet for a 20 kiloton blast), nuclear tests would not release any radioactive material into the air, but distinguishing these tests from normal earthquakes on a seismograph was actually somewhat difficult. The only sure way to tell if a tremor had been produced by a blast or an earthquake would be to send in an inspection team, but it was still unclear how many U.S. inspection teams a year Russia would tolerate.⁸⁵

Other issues of detection still existed, but Bethe also questioned whether the Soviet Union would try to violate any test ban by carefully using natural formations to evade detection. Techniques like decoupling could be used to deliberately conceal

⁸⁴ DDEL, John A. McCone Papers, Box 4, Folder RES&D 1-2 -- TESTING -- March 1960 - July 1960 [Folder 1] (1), Position Paper: Nuclear Test Suspensions High Altitude Detection Problem, 21 July 1960

⁸⁵ DDEL, John A. McCone Papers, Box 4, Folder RES&D 1-2 -- TESTING -- March 1960 - July 1960 [Folder 1] (1), Memo From S. G. English To Chairman McCone, Commissioner Graham, Commissioner Wilson, Commissioner Olson, 28 July 1960

nuclear tests, such as setting off the bomb in a large cavern so that “the apparent size of the explosion is thereby reduced by a factor of about 300.” Making a hole large enough is problematic, but using a salt cavern and washing away the salt was not as difficult (though it would take about 2 years and around \$10 million). Such an endeavor, of course, would still be quite an effort. No matter the trouble, Bethe’s fundamental position was such: “I believe that the Soviet Union, which is posing as a peace-loving nation, whether rightly or wrongly, simply cannot afford to be caught in a violation, and therefore I think that it will not try to cheat.” Beyond that, cheating and conducting one test would not be terribly useful—any country would have to be a serial violator for its efforts to pay off. Moreover, researching possible concealment just to make better detection systems would only do the research for a possible violator, which seemed like a poor plan.⁸⁶

In short, Bethe expressed the common opinion that a test ban should be implemented and it would be to the United States’ advantage. There still existed some technical issues on detection, which he outlined in his article, but these either needed to be solved or ignored. Bethe wrote in conclusion, “Opponents of the test cessation agreement want to have a perfect agreement; they want to have an agreement in which we can be sure to detect each and every violation, no matter how small. I think that by insisting on perfection we shall end up with nothing.”⁸⁷ Many U.S. policymakers, however, did not agree, and the Eisenhower administration never did deviate from its

⁸⁶ DDEL, John A. McCone Papers, Box 4, Folder RES&D 1-2 -- TESTING -- March 1960 - July 1960 [Folder 1] (1), Memo From S. G. English To Chairman McCone, Commissioner Graham, Commissioner Wilson, Commissioner Olson, 28 July 1960

⁸⁷ DDEL, John A. McCone Papers, Box 4, Folder RES&D 1-2 -- TESTING -- March 1960 - July 1960 [Folder 1] (1), Memo From S. G. English To Chairman McCone, Commissioner Graham, Commissioner Wilson, Commissioner Olson, 28 July 1960

original position. Eisenhower's briefing papers before his 17 August press conference stated that the U.S. still intended to negotiate for a control system, "which would assure that no nuclear weapons tests are carried out clandestinely. However, until such a system is brought into being we have no way of being absolutely certain that the Soviet Union is not testing clandestinely."⁸⁸

As Eisenhower's term ended, it became even clearer that an agreement would not be reached during his term. The United States had suspended weapons tests for more than two years, since October 1958, both to aid in negotiations and also because "radioactivity from nuclear tests is a source of concern in the minds of many people."⁸⁹ The U.S. position still rested on issues of detection and the U.S. worry that its own security, and by extension that of the rest of the world, might be harmed by stopping nuclear weapons tests.

In the end, President Eisenhower felt that the U-2 affair—and not disagreements about control systems—had ruined any chance the U.S. had to help make any test cessation agreement and perhaps even more. After the incident, George Kistiakowsky, presidential scientific advisor, met with Eisenhower and the subject of the U-2 plane came up in their conversation. Eisenhower claimed that the scientists had let him down, but Kistiakowsky responded that scientific advisors had warned the President that the Soviets would eventually gain the capability shoot down the planes. Instead,

⁸⁸ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Press Conference Series, Box 10, Press Conference 17 August 1960, Briefing Papers

⁸⁹ Of course, the quotation continued to say: "regardless of whether or not the fears of fallout radiation are scientifically valid. Accordingly, the Commission would propose that future tests, if any, be conducted underground, or in space beyond the earth's atmosphere, in such a way as not to cause fallout." *Annual Report to the Congress of the Atomic Energy Commission for 1960, January 1961*, XIII-XIV. A good brief summary of the negotiations is contained on pages 125-127.

Kistiakowsky declared that it was the bureaucrats running the program who had let down the President. At that point:

[The] President began to talk with much feeling about how he had concentrated his efforts the last few years on ending the cold war, how he felt that he was making big progress, and how the stupid U-2 mess had ruined all his efforts. He ended very sadly that he saw nothing worthwhile left for him to do now until the end of his presidency.⁹⁰

But perhaps President Eisenhower misjudged the situation, and a fundamental difference in positions—especially related to detection systems—meant that blaming the U-2 incident does not make sense. Instead, it is very possible that the United States and Soviet Union simply were not in the correct respective places for the agreements to be feasible.

What is clear, though, is the crucial role that the natural world and scientific understandings about it played in the negotiations. Both negotiating sides were concerned about fallout and especially how the radiation would be transferred from testing environments to human bodies. It was this fear that undergirded the entire negotiation process, especially as poisoning the environment might damage the United States' reputation or be used by the Soviets as propaganda. Thus, whether induced by heartfelt concern or political maneuvering, policymakers and negotiators should be taken at their word in this instance—protecting the environment mattered. Moreover, policymakers' decisions helped enact an institutional position that improving environmental knowledge about the nuclear complex was crucial to bettering national security in a Cold War geopolitical context.

Beyond a desire to protect the natural world, environmental science played a crucial part in the largest point of discussion in all treaty talks—detection systems. Put simply, both sides thought testing should be curbed, at least to some significant degree,

⁹⁰ Kistiakowsky, *A Scientist at the White House*, 375.

but could not agree on how such a ban might be monitored, or even if it should.

Representing a fundamental lack of trust in the Soviets' willingness to maintain any agreement reached, the United States insisted on only banning tests that could be effectively monitored. For tests to be monitored and detected, scientific understandings of the environment proved central. Not only did tests conducted aboveground leave telltale radiation in the atmosphere, which could be detected, but the ground itself and tremors throughout it took center stage when discussing underground tests. The whole detection argument centered on environmental knowledge and how it had to be continually improved so that detection systems also could improve.

In sum, environmental science and knowledge must be recognized as crucial components of early nuclear test cessation treaty talks. Without sensitivity to the natural world and understandings of it, nuclear test ban discussions would have happened very differently or likely not at all. In addition, the Eisenhower-era treaty talks represent the antecedent action to the 1963 Limited Test Ban Treaty, which followed closely many of the U.S. requirements established before Kennedy even took office. Though the talks during the Eisenhower presidency failed while those during the Kennedy administration succeeded, these earlier treaty discussions still deserve recognition and understanding, both for their place in Cold War history and for how they help illuminate this under-recognized relationship between the environment and the Eisenhower administration.

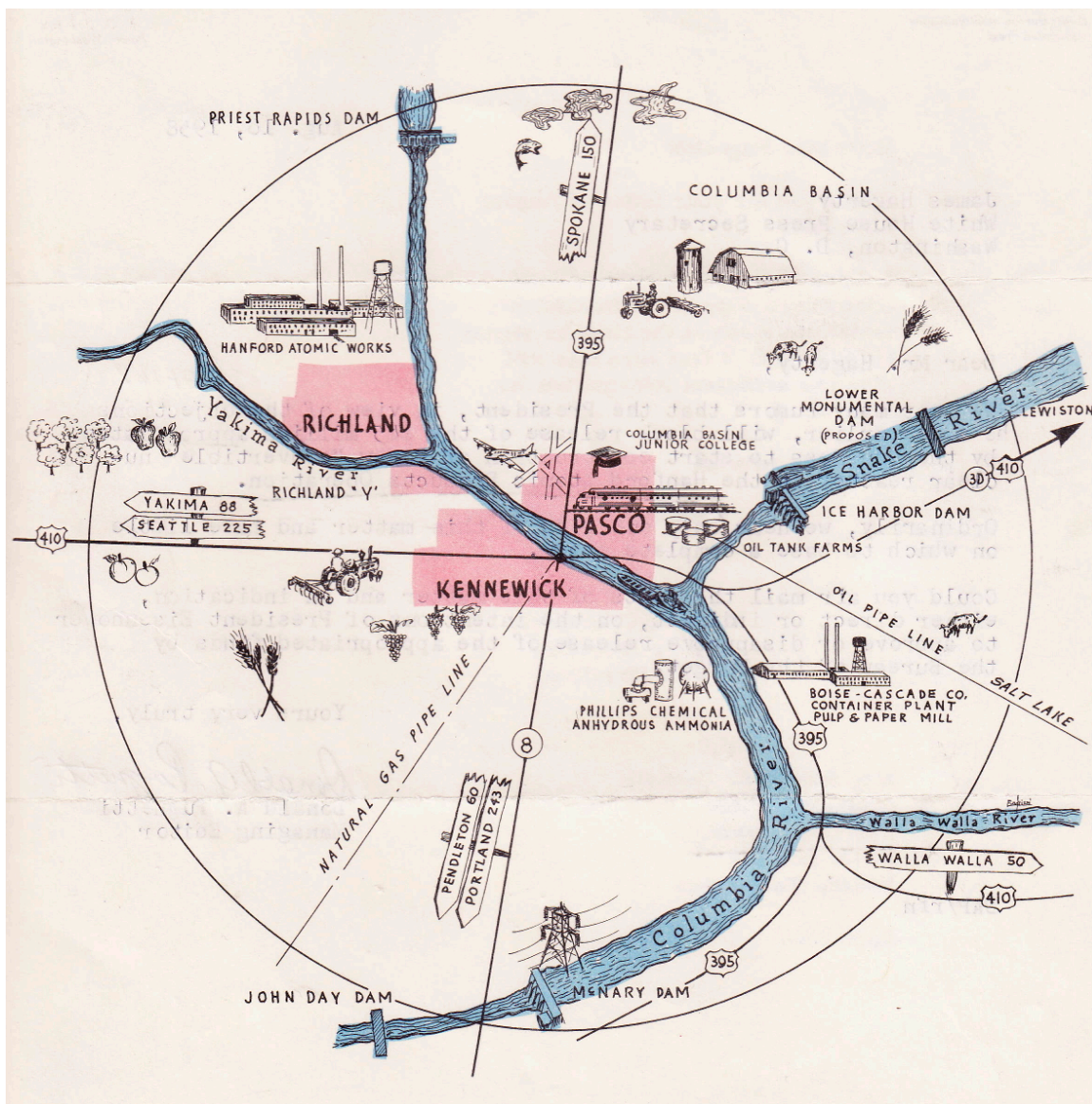


Figure 1: Hand Drawn Map of Hanford Atomic Works Area¹

Notice how natural and agricultural factors are interspersed with industrial centers of both traditional and nuclear varieties.

¹ DDEL, White House Central Files, General File, Box 1214, Folder 155, 1958, Letter from Donald A. Pugnetti to James Hagerty, 16 August 1958.

PRODUCTION of FISSIONABLE MATERIALS

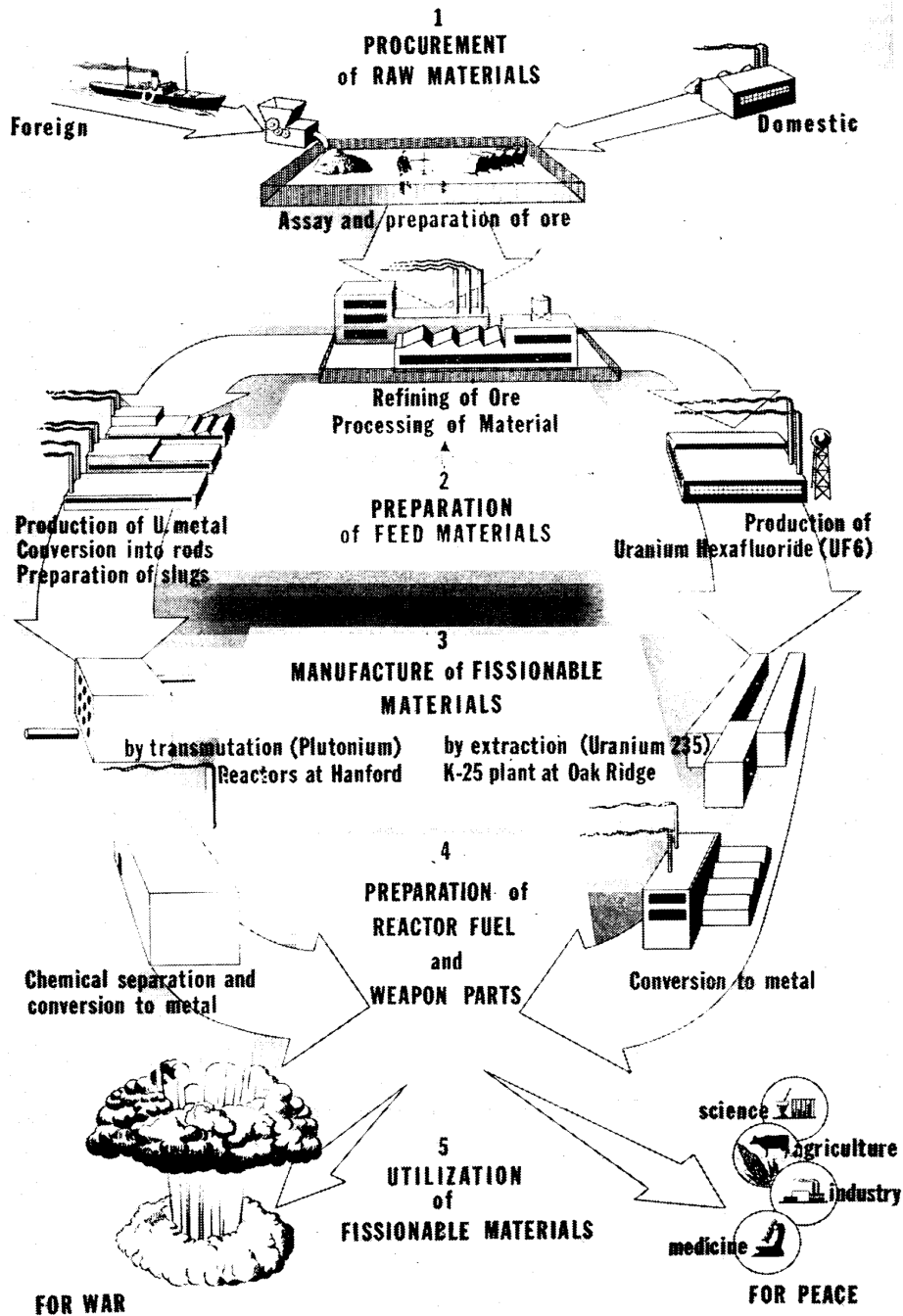


Figure 2: Step-by-step chart from the AEC on the production of nuclear products²

Notice that the chart implies that peaceful and war uses of fissionable materials receive and equal amount of time, attention, and research, and also that the two are merely halves of the same coin. Moreover, neither mining nor nuclear waste are mentioned at all.

² Fifth Semiannual Report of the Atomic Energy Commission, January 1949, 4.



Figure 3: “Trinity,” the world’s first detonation of a nuclear weapon³

After this test, which occurred on 16 July 1945, Robert Oppenheimer proclaimed, quoting from the *Bhagavad-Gita*, “I am become Death, the shatterer of worlds.”

³ Photo accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Trinity_shot_color.jpg Quotation from Donald Worster, *Nature’s Economy* (San Francisco: Sierra Club Books, 1977), 339.

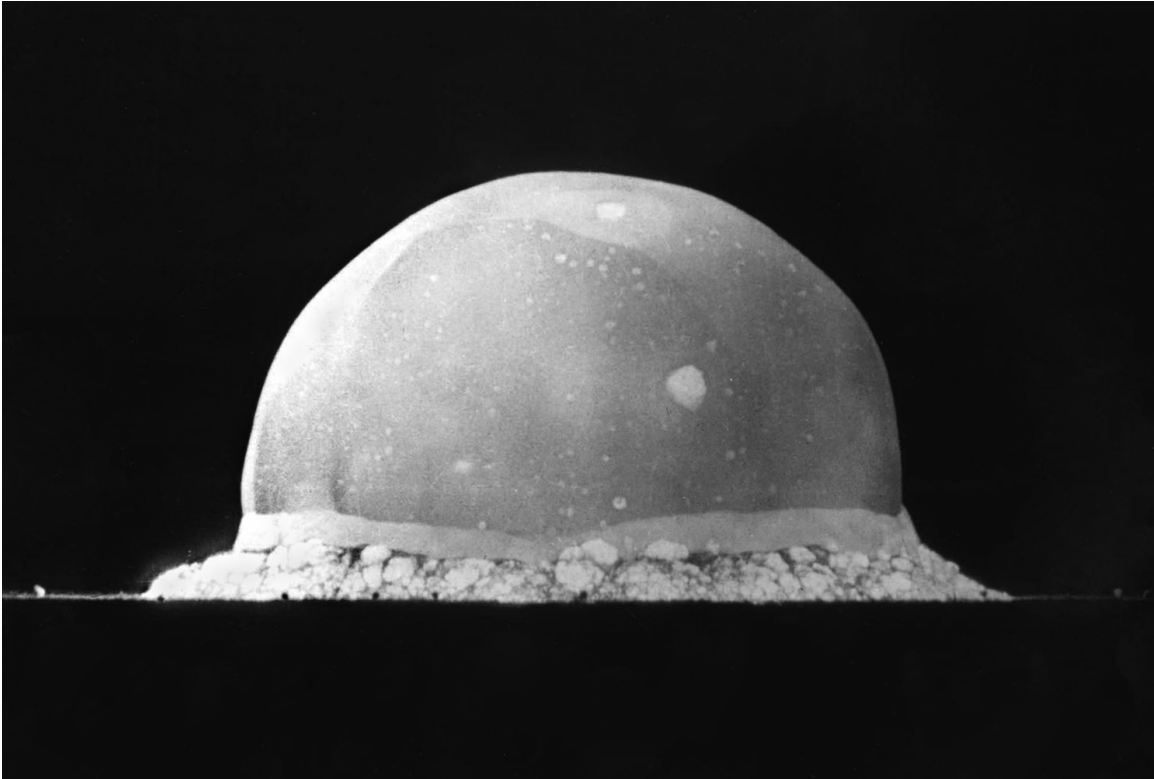


Figure 4: The Trinity shot 16 milliseconds after detonation⁴

At this point, the fireball is about 600 feet wide.

⁴ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Trinity_Test_Fireball_16_ms.jpg



Figure 5: Operation Crossroads “Able” shot, detonated 1 July 1946⁵

Able was the first post-World War II nuclear test.

⁵ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Operation_Crossroads_-_Able_001.jpg

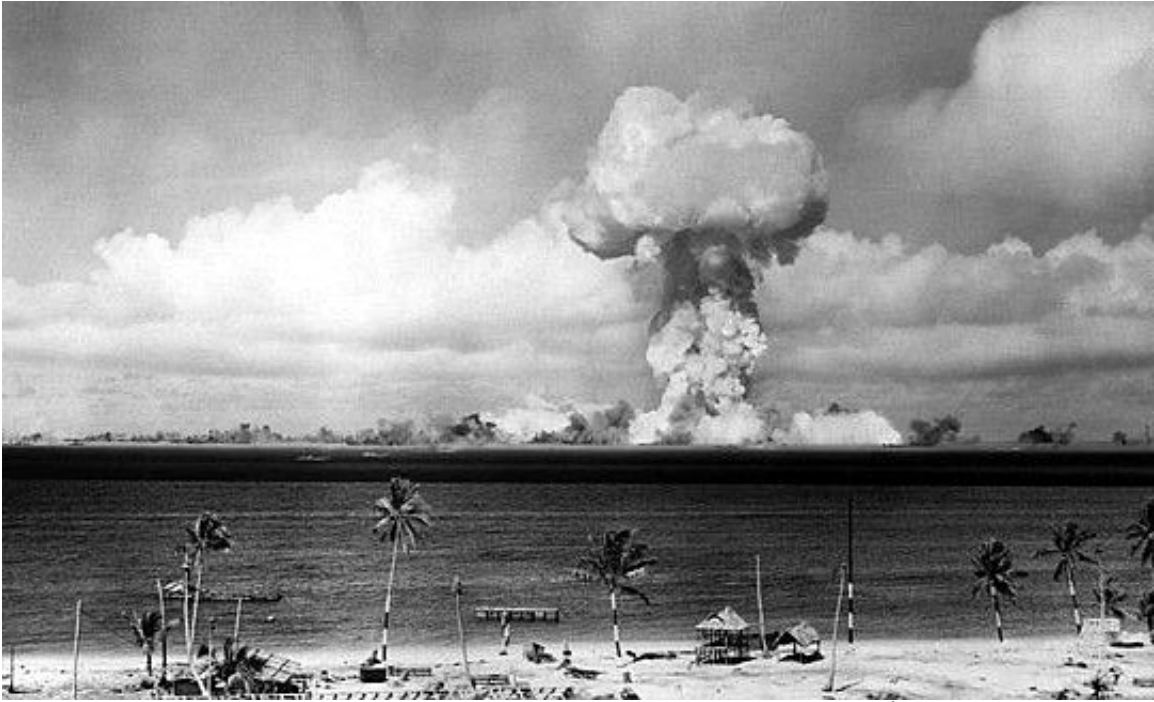


Figure 6: Another view of the Operation Crossroads “Able” shot⁶

The juxtaposition between beautiful, natural features in the foreground and the iconic mushroom cloud in the background reminds us that nuclear tests were always situated within an environmental context.

⁶ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Able_crossroads.jpg

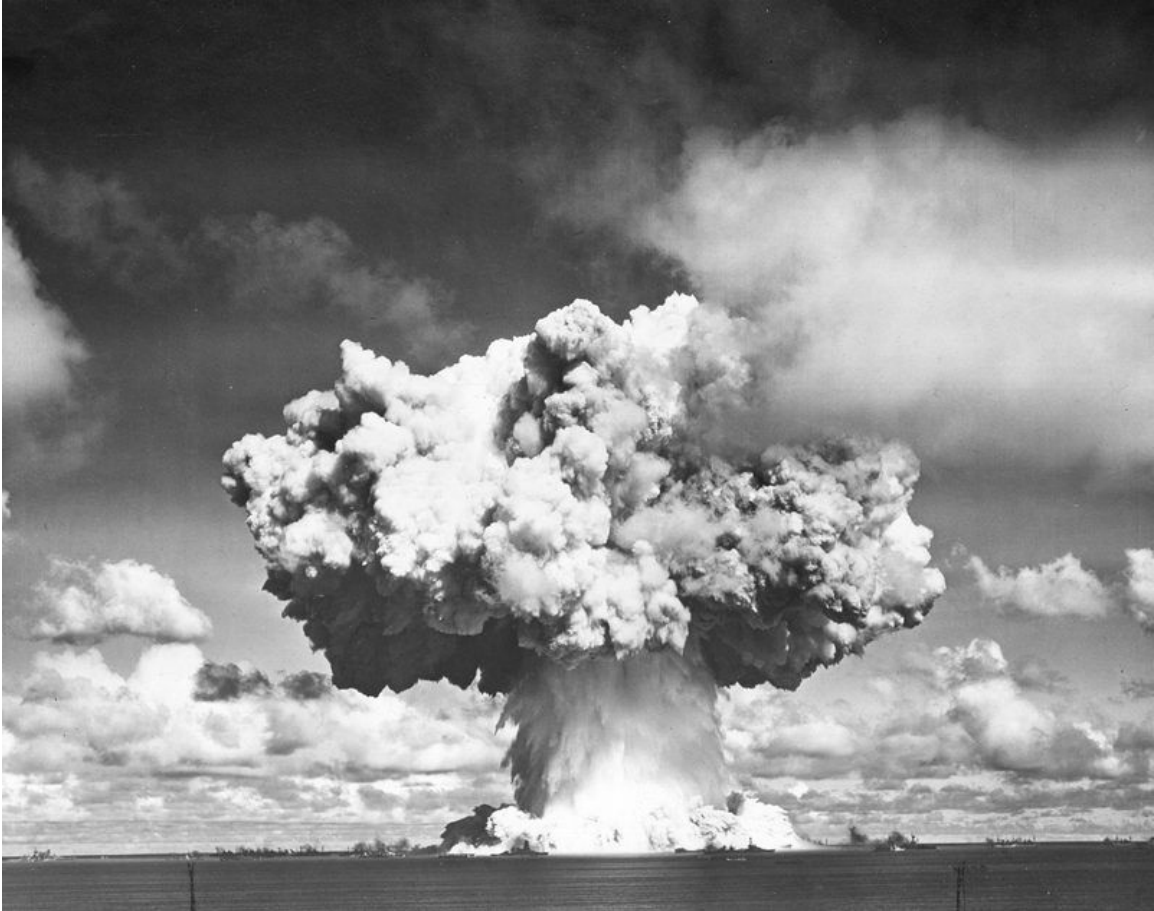


Figure 7: Operation Crossroads, “Baker” shot, detonated 25 July 1946⁷

This underwater detonation spewed copious radioactive water into the air and carried it out in hundred-foot tall waves.

⁷ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Operation_Crossroads_Baker.jpg

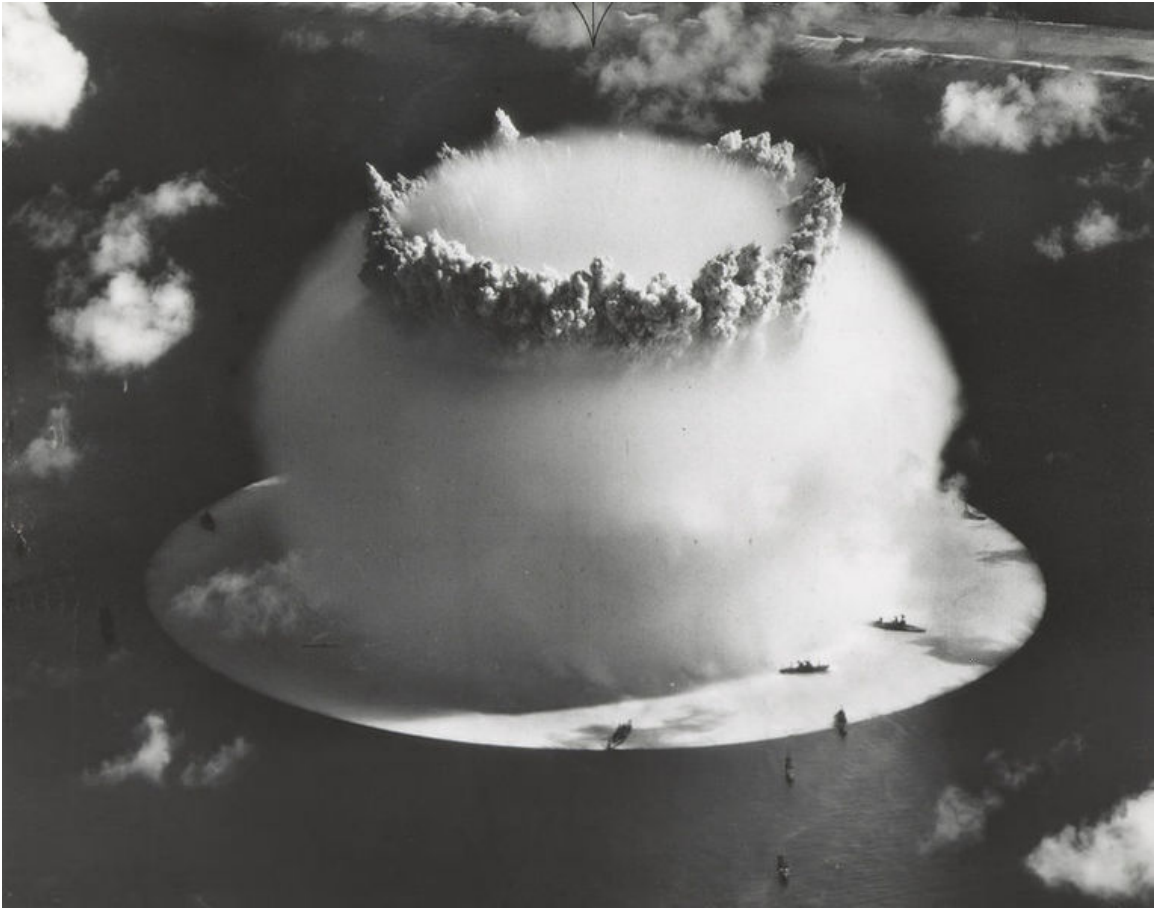


Figure 8: Operation Crossroads, Baker shot⁸

From this angle it is easy to see the ships moored at varying distances around the blast epicenter and the considerable spray of water.

⁸ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Crossroads_baker_explosion.jpg



Figure 9: Another view of Operation Crossroads “Baker” shot⁹

In this photograph, both the moored ships and nuclear test (at the time the height of technology) combine with the palm trees (reminiscent of a tropical paradise) create an almost paradoxical scene.

⁹ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Operation_Crossroads_Baker_Edit.jpg

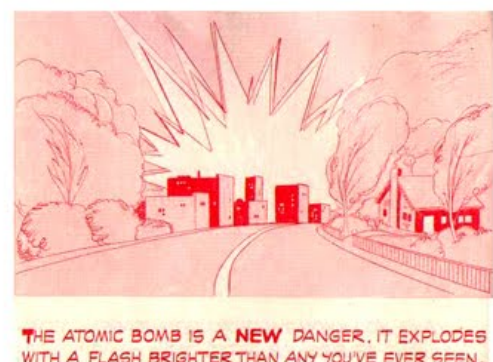
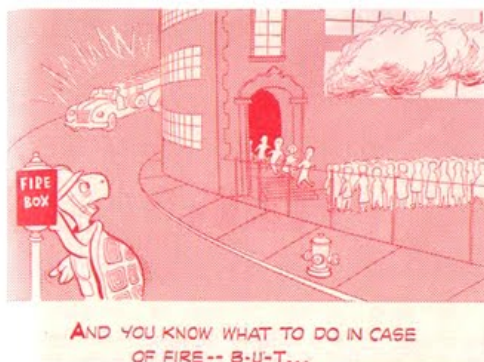
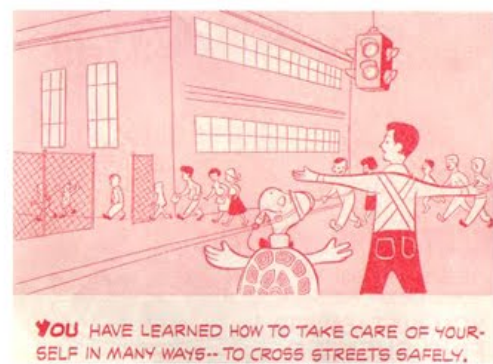


Figure 10: A comic about Bert the Turtle in the same vein as the popular short film *Duck and Cover*, first page

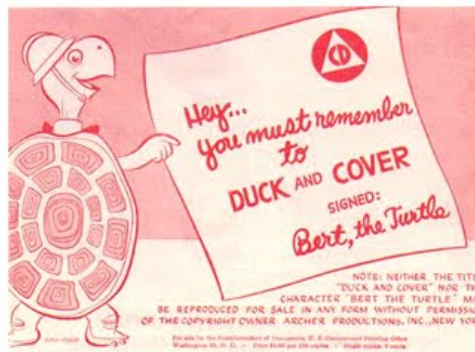
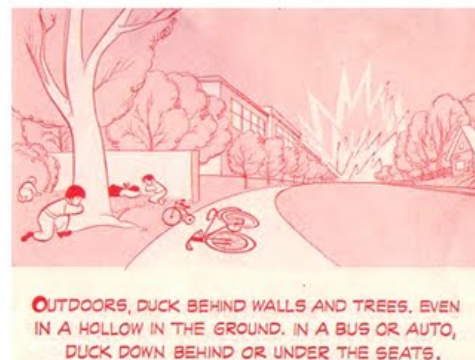
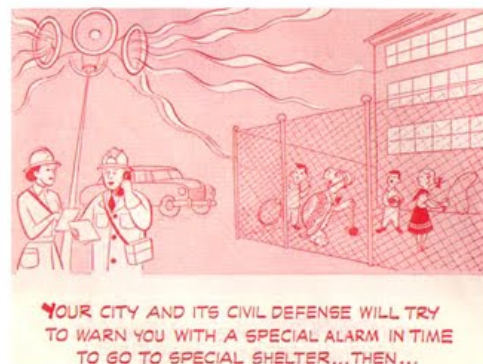


Figure 11: A comic about Bert the Turtle in the same vein as the popular short film *Duck and Cover*, second page



Figure 12: The Operation Castle “Bravo” test, detonated 1 March 1954¹⁰

This bomb, one of the first thermonuclear weapons detonated, caused the *Lucky Dragon* controversy and showered the Marshall Islanders with radioactive fallout.

¹⁰ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Castle_Bravo_Blast.jpg



Figure 13: Weather balloons used for stratospheric fallout monitoring¹¹

Balloons like these marked the confluence of U.S. nuclear weapons advancement and the interests of U.S. scientific advancement.

¹¹ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 3, Folder Stratospheric Monitoring, Jan. 1958, #2, Balloons Photo

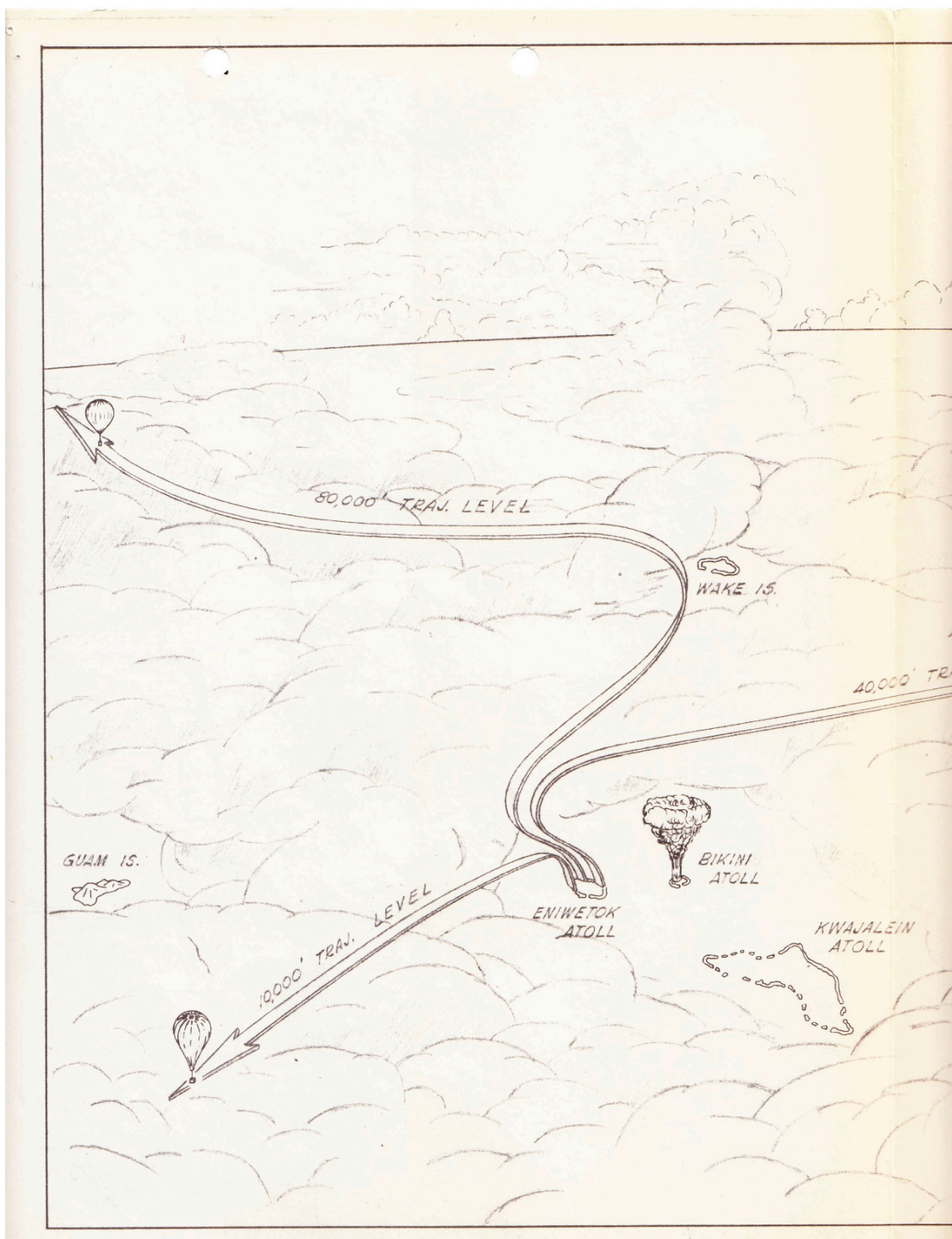


Figure 14: Drawing on the use of weather balloons to monitor stratospheric fallout in the Pacific, left half¹²

¹² NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, Box 3, 1953-6, Folder Stratospheric Monitoring, Jan. 1958, #2, Constant Level, Balloons as Tracers of Air Motion in Atomic Weapon Tests for the Atomic Energy Commission

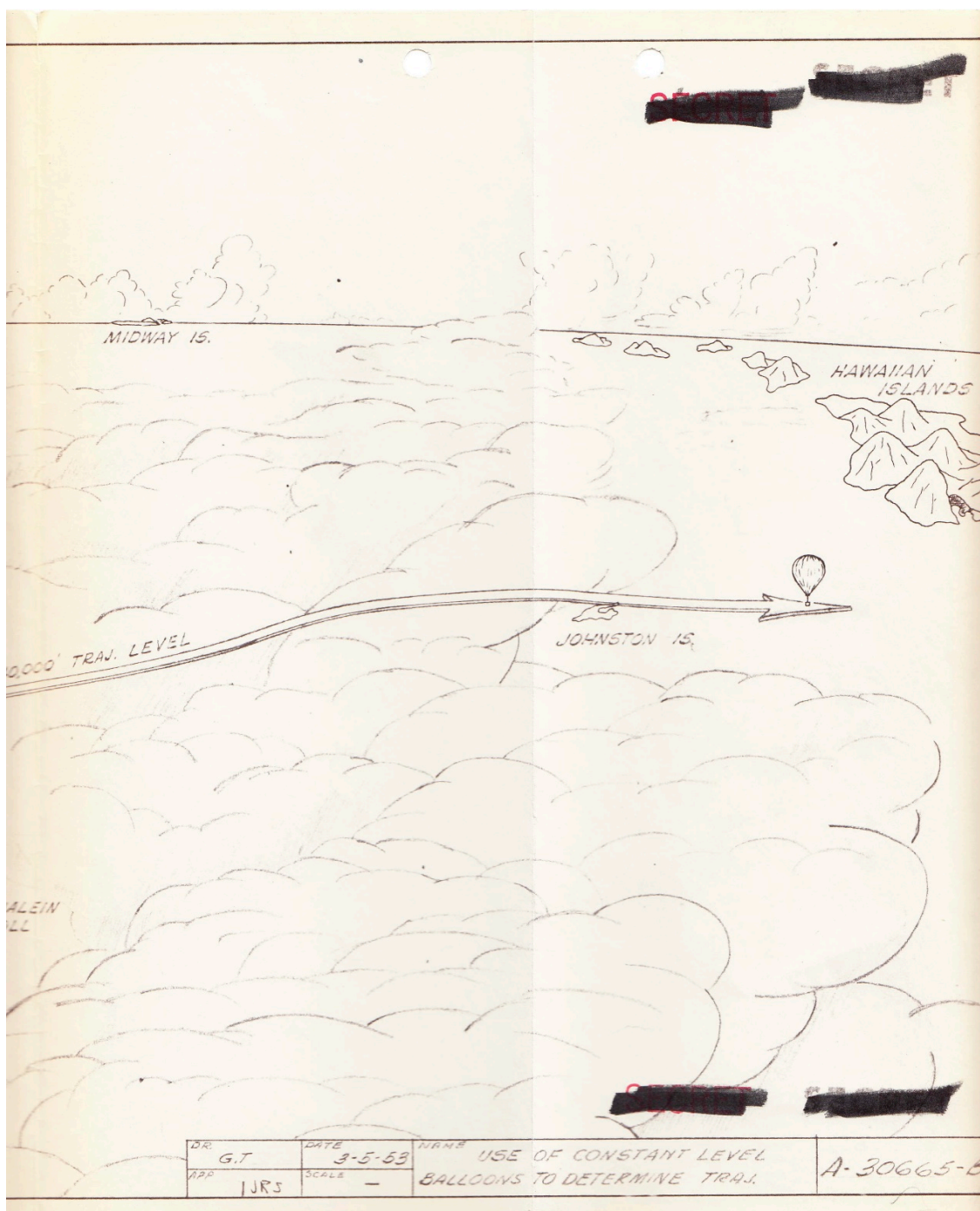


Figure 15: Drawing on the use of weather balloons to monitor stratospheric fallout in the Pacific, right half¹³

This drawing, in conjunction with the previous figure, conveniently hides most of Micronesia under cloud cover, including heavily populated downwind locales like most of the Marshall Islands. Perhaps most notably, strategic U.S. interests—like Midway and Hawai'i—feature most prominently on the map.

¹³ IBID.



Figure 16: “Safe, Harmless Giant Atomic Bomb” Toy¹⁴

Toys like this, even with scenes of destruction on the box, belied the fact that nuclear weapons were not safe, even with the best intentions of policymakers and scientists to make such bombs “clean.”

¹⁴ Accessed on 2 April 2012 from http://en.wikipedia.org/wiki/File:Giant_Atomic_Bomb_toy.jpg

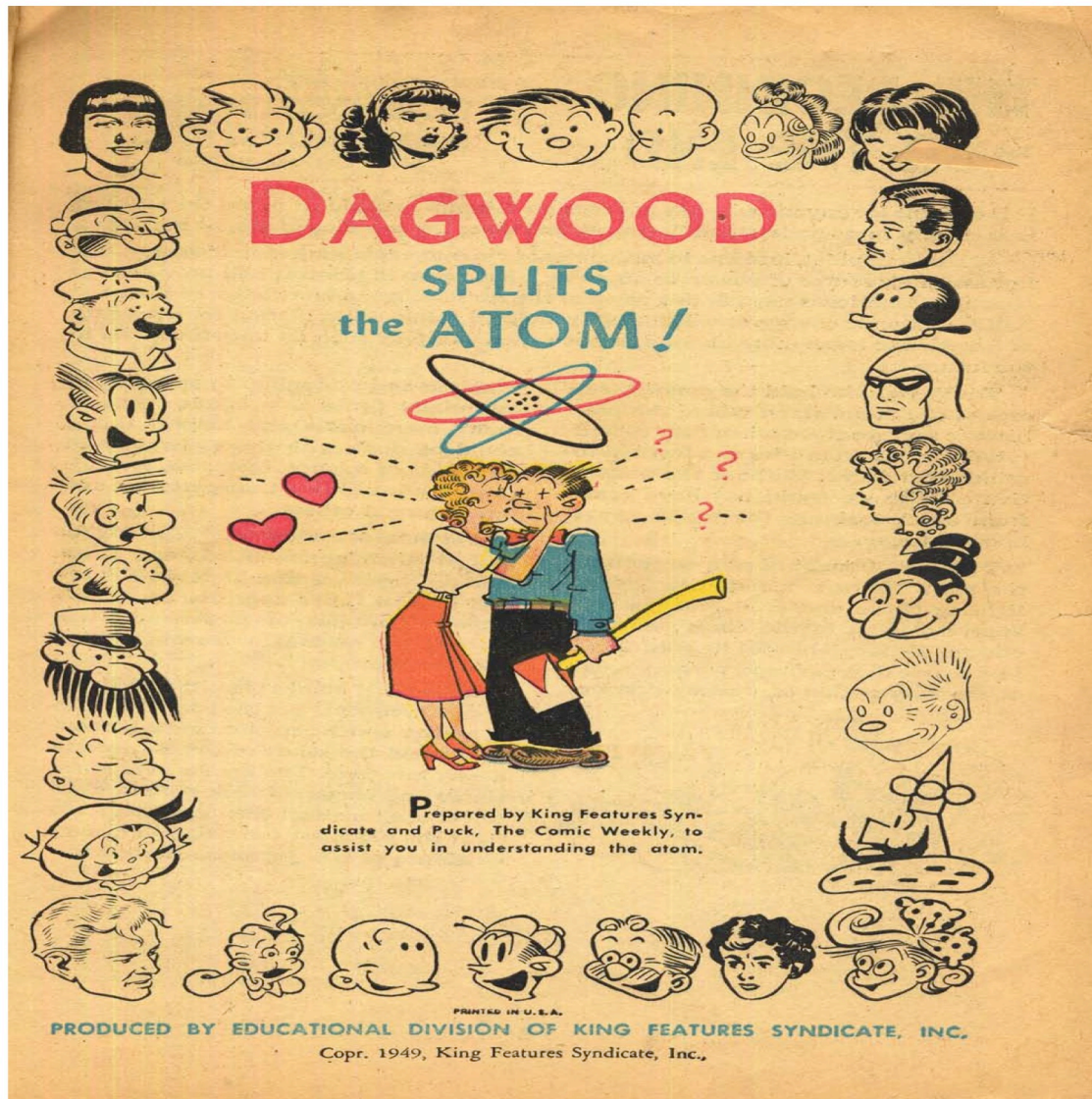
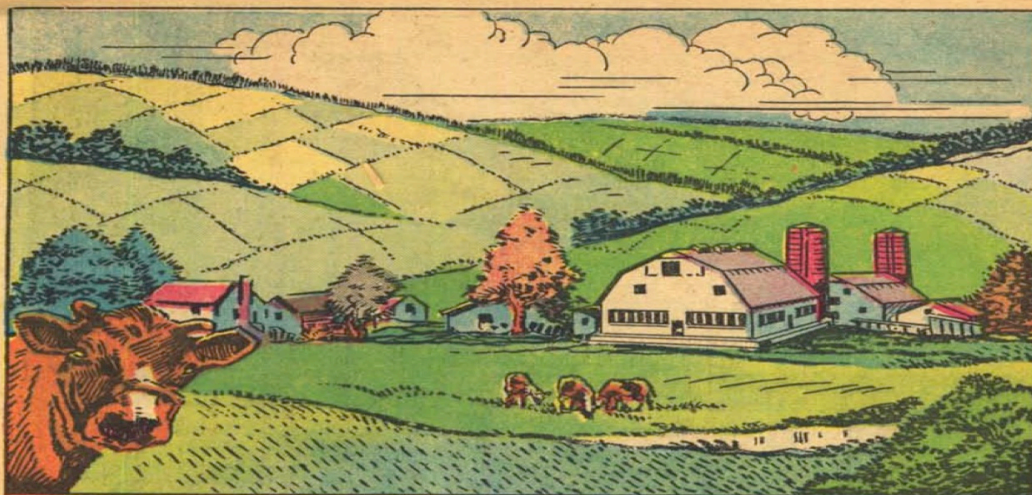


Figure 17: Cover of *Dagwood Splits the Atom*¹⁵

This booklet attempted to explain, in very plain English, exactly how many nuclear processes happened and certainly is representative of nuclear boosterism. Though produced by King Features Syndicate, Inc., a comic and newspaper print syndication, author Joe Musial wrote the work with the scientific advice of Lt. General Leslie R. Groves, Dr. John R. Dunning, and Dr. Louis M. Heil. In the introduction, Groves, described as having “headed the great organization which developed the atomic bomb” (the Manhattan Project), wrote to readers, “To those who will read it carefully, this pamphlet will bring a clearer understanding of atomic energy. Many will understand what has formerly confused them. Mere words need not frighten them in the future—words such as fission, isotope, proton, chain reaction and atom bomb. This book will reassure the fearful that the future can be made bright.”

¹⁵ Joe Musial, *Learn How Dagwood Splits the Atom!* (King Features Syndicate, Inc., 1949), introduction.
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AGRICULTURE

AGROWING plant is a chemical factory, of course. Scientists have known this for years—but haven't known exactly what went on in that factory. They didn't know and couldn't find out how chemicals entered the plant, what the chemicals did, how they accomplished their work. So, agriculture has had to depend on trial-and-error in producing vital food.

Now agricultural science has perfected a way for studying and following plant chemicals from the time they leave the soil until they are finally deposited in the various parts of the plant. By mixing small quantities of radioactive isotopes with the soil, the scientist, with his Geiger counter, can now follow the movement of important chemicals through the whole cycle of plant life.

Potash, needed by growing plants, is stored in the soil—but nobody has known how. Now science is learning the answer by following with a Geiger counter the movement of radioactive potassium atoms in the potash.

The growth of plants is known to be regulated by plant hormones. Just how plant hormones stimulate plant growth is a question which, if answered, would mean millions more bushels of food. The action of plant hormones in producing growth is being probed by radioactive atoms and Geiger counters.

A big question that has baffled science is, how does a green leaf change the energy of sunlight into the energy of starches and sugars in the plant? The scientists call this process "photosynthesis", and with the aid of radioactive isotopes they soon may find the answer.

Most of the present study with radioactive isotopes in agriculture is concerned with the nature of plants. Later this knowledge will be applied to the treatment of plants not only for healing their diseases but also for making them more resistant to pests and hardships.

Food production, therefore, is passing from trial-and-error to certainty.

Figure 18: Page 31 of *Dagwood Splits the Atom*¹⁶

This one-page section of *Dagwood Splits the Atom* helped explain how agriculture could expect to see big gains from atomic research.

¹⁶ Joe Musial, *Learn How Dagwood Splits the Atom!* (King Features Syndicate, Inc., 1949), 31.
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Chapter Four

Atomic Agriculture: The Atom, Agriculture, and Hopes for Technology

“A growing plant is a chemical factory, of course. Scientists have known this for years—but haven’t known exactly what went on in that factory. They didn’t know and couldn’t find out how chemicals entered the plant, what the chemicals did, how they accomplished their work. So, agriculture has had to depend on trial-and-error in producing vital food.

“Now agricultural science has perfected a way for studying and following plant chemicals from the time they leave the soil until they are finally deposited in the various parts of the plant. By mixing small quantities of radioactive isotopes with the soil, the scientist, with his Geiger counter, can now follow the movement of important chemicals through the whole cycle of plant life. [...]

“Food production, therefore, is passing from trial-and-error to certainty.”¹⁷

—*Learn How Dagwood Splits the Atom!* (1949)

The loveable cartoon character Dagwood Bumstead is best known for eating impossibly large sandwiches, napping, and of course his beautiful wife Blondie. During the Cold War, however, the United States enlisted the good patriot Dagwood to help teach the nation about nuclear science. In *Learn How Dagwood Splits the Atom!*, the magician Mandrake shrank our animated protagonist and his family to the size of molecules, and in their diminutive states the Bumsteads learned about the composition of atoms and how nuclear chain reactions work. The booklet not only sent Dagwood on his miniaturized journey, but also, unsurprisingly, acted as a booster for the nuclear industry.

In this mission as a booster, *Learn How Dagwood Splits the Atom!* (Figure 16) also promoted the benefits of the harnessing the atom to improve agriculture. Completely outside the tiny Dagwood story arc, several pages at the end of the comic were single-page snapshots of how atomic energy had benefitted, and would continue to benefit in the

¹⁷ Joe Musial, *Learn How Dagwood Splits the Atom!* (King Features Syndicate, Inc., 1949), 31

future, medical science, industry, and agriculture (Figure 18). As the quotation at the start of the chapter shows, atomic tracers could track “plant chemicals from the time they leave the soil until they are finally deposited in the various parts of the plant” and seemed to be a miracle technology that would soon transform growing food from “trial-and-error to certainty.” Such statements held a clear implication: if researchers could only understand the exact biological processes that govern how plants grow and produce food, those scientists would be able to help farmers feed the nation in a failsafe fashion. As an Atomic Energy Commission (AEC) report to Congress in the same year of the Dagwood cartoon’s publication claimed, “The story of the Garden of Eden and the myth of Promethean fire find uncanny parallels in the huge responsibilities of the Atomic Energy Commission to control the unprecedented forces of atomic energy for the welfare of man.”¹⁸ With atomic energy and its lessons, U.S. policymakers hoped to turn the country’s agricultural lands into a modern-day Garden of Eden, albeit with less devastating apples.

The Dagwood cartoon is important for the attitudes and mindsets it represents. The cartoon is emblematic of how, during the Truman and Eisenhower administrations, policymakers paid careful consideration to the ways growing nuclear scientific understandings might be applied outside of improving war-making capabilities. General Leslie Groves, former head of the Manhattan Project, wrote of *Learn How Dagwood Splits the Atom*, “This book will reassure the fearful that the future can be made bright.”¹⁹ Similarly, agriculture frequently assumed a place of prominence for explaining how splitting the atom was a gift to the world and not the red horse rider of the apocalypse.

¹⁸ *Sixth Semiannual Report of the Atomic Energy Commission, July 1949*, 16.

¹⁹ Musial, *Learn How Dagwood Splits the Atom!*, introduction.

Historian Joel B. Hagen has described how many people, specialists and not, quickly realized that atomic energy could pose incredible dangers to both human health and the environment. Hagen explained that, “In response, professional ecologists effectively used concerns over atomic energy as a convincing justification for ecosystem studies.” He further elucidated that for postwar professional ecologists (or in our case, agronomists), nuclear energy became “a kind of double-edged sword” that could wreak havoc on the natural world, but also unlock “many of nature’s secrets for human benefit.”²⁰ In the same way, research into atomic agriculture allowed U.S. policymakers to simultaneously increase research into atomic energy and how it affected the natural world without necessarily creating bombs that could cause incredible harm to both human and natural systems, as previous chapters have showed.

This chapter traces how top decision makers during the Truman and Eisenhower administrations understood the relationship between agriculture and the atom and how they explained their understandings to other policymakers and the public. While nuclear science proved incredibly important to agriculture during the 1940s and 1950s, particularly with radioactive tracer isotopes, this chapter argues that agriculture was also important for nuclear development as it provided a clearly peaceful output for atomic research. To show this, the chapter particularly looks at the research reported by the AEC to Congress and what this research explains about the mindsets and goals of AEC policymakers—where the AEC put its time and money and what it thought worth telling Congress tells us a great deal about what policymakers thought about atomic agriculture. Worth noting in this discussion is that atomic agricultural research could and did take

²⁰ Joel B. Hagen, *An Entangled Bank: The Origins of Ecosystem Ecology* (New Brunswick: Rutgers University Press, 1992), 100-101.

many forms, especially including the byproducts of nuclear energy like radioactive isotopes and even radioactivity itself. What tied together these disparate research methods and atomic energy products is that all of these fell under the umbrella of the AEC, further emphasizing the sweeping nature of the nuclear complex. After 1945 high-level decision makers recognized they would need to justify research into atomic energy and downplay the possible harms inherent in it.

Executive policymakers, especially in the AEC not only wanted to help improve the nation's agriculture, but more importantly they saw that doing so would represent their commitment to more than creating weapons of greater and greater mass destruction. In short, atomic agriculture represented an attempt by policymakers at repurposing atomic energy research as a peaceful endeavor. Those decision makers intended atomic agriculture to create hope for the future and a belief that technology and greater control of nuclear energy could create a better nation. Moreover, they realized that if the AEC helped improve agriculture that agriculture could help the AEC better develop atomic energy and cast its research into a much more publicly palatable form.

In order to understand this interplay between the atom and agriculture, however, atomic agriculture must be placed in several different contexts—the developing nuclear complex, the modernization of agriculture, and the Green Revolution.²¹ Agricultural modernization and the Green Revolution require some additional background at this juncture. Farmers in the United States began their journey to modernized farm production

²¹ These contexts continued to intertwine after 1960 as well as shown by historian Jacob Darwin Hamblin, who traced the “origins of the [Food and Agriculture Organization and International Atomic Energy Agency] conflict and collaboration in the 1960s, and [explored] the failed effort of plant geneticist Ronald Silow to stop what he saw as the IAEA’s hijacking of agriculture at the [United Nations].” Jacob Darwin Hamblin, “Let there be light ... and bread: the United Nations, the developing world, and atomic energy’s Green Revolution,” *History and Technology*, Vol. 25, No. 1 (March 2009), 25.

in the nineteenth century, but after the First World War that action accelerated.²² Farmers adopted more machines, particularly machines powered by hydrocarbon fuels like gasoline, and these mechanical aids let farmers do their jobs easier, quicker, and with less human labor. With those machines came a rising industrial logic as well, as the transformation also had an ideological component.²³ After World War II, agriculture took off in an even more spectacular way, as “During the generation after [World War II], agriculture underwent a revolution in productivity spurred by machines, chemicals, and improved plant and animal breeds.”²⁴ Continued use of machines combined with a budding U.S. chemical industry as tractors went hand in hand with fertilizers, herbicides, and pesticides.²⁵ The process did not happen seamlessly, however, and farmers made many individual decisions along the way as the process advanced in starts and fits.²⁶ In

²² One excellent example of both the technologies and mindsets involved in modernized agricultural production can be found in Melody Petersen, “As Beef Cattle Become Behemoths, Who Are Animal Scientists Serving?” *The Chronicle of Higher Education*, 15 April 2012. Can be found online: <http://chronicle.com/article/As-Beef-Cattle-Become/131480/> accessed 9 September 2012.

²³ Deborah Fitzgerald argued, “although individual technologies, particular pieces of legislation, new sorts of expertise, and the availability or disappearance of credit opportunities are all key to understanding what happened in twentieth-century agriculture, it is essential to grasp the overarching logic of change that was taking place in bits and pieces and the industrial system that was being constructed around the country.” Deborah Fitzgerald, *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven: Yale University Press, 2003), 4.

²⁴ David Danbom’s history of the rural United States focuses on farming peoples as exemplary of rural life in the country. His larger argument for this time period is that “Socially, culturally, materially, and in terms of life experiences, rural life was converging with urban life in the decades following World War II.” David B. Danbom, *Born in the Country: A History of Rural America* (Baltimore: The Johns Hopkins University Press, 1995), 233-234, 252. And neither modern rural life nor farm production would not be the same without the development of prefabricated housing. John Fraser Hart, Michelle J. Rhodes, and John T. Morgan, *The Unknown World of the Mobile Home* (Baltimore: The Johns Hopkins University Press, 2002)

²⁵ One of the very best examinations of the development of the U.S. chemical industry surely is Edmund Russell’s study of pesticides and war gases that argues the two coevolved, especially in the rhetoric of their producers. Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring*. (Cambridge: Cambridge University Press, 2001)

²⁶ This is as is argued by J. L. Anderson in *Industrializing the Corn Belt*. Anderson tried “to explain farmers’ roles in changing agricultural production, to describe the technology they adopted, and to show how they transformed the rural landscape,” particularly through the perspective of farmers. Fundamentally, he contends, “Farmers who worked the land during the postwar period not only accepted the industrial ideal but made it their own,” and in doing so “the ecosystems and physical landscape of Iowa farms changed as a result of many thousands of small decisions concerning the use of technology.” J. L. Anderson,

the end, farming became more of a business, leading to the current state of trucking cheaply-produced agricultural products across the country to feed a nation that eats more and at less expense than any before it in history.²⁷

Once the United States reached that situation, however, a series of decisions to share the methods to such agricultural productivity coalesced into what is commonly called the Green Revolution. Previous world hunger, such as the El Niño-exacerbated *fin-de-siècle* drought famines that killed tens of millions, had elicited little attention from the United States and especially the U.S. government.²⁸ After World War II the world political climate changed enough that feeding the world and eradicating hunger became an important political goal. In addition to previously described mechanical and chemical advances, improved plant breeding also played a crucial role in getting food to mouths. In particular, improved cereal grain crops like highly productive dwarf wheat and rice

Industrializing the Corn Belt: Agriculture, Technology, and Environment, 1945-1972 (DeKalb: Northern Illinois University Press, 2009), 5-12, 192.

²⁷ On family farming becoming a business, see John Fraser Hart's *The Land That Feeds Us*. He argues that post World War II U.S. agriculture became an increasingly international enterprise because farmers in the country were just too good at what they did, leading to surpluses. "The United States has more good farmland than it needs to feed and clothe its people, so American farmers must export because they can produce more than the American people can consume. The surplus may be either a vexatious problem that must be controlled or a blessing that should help to feed a hungry world, but American farmers suffer when other countries, for whatever reason, do not or cannot buy the surplus they have produced." John Fraser Hart, *The Land That Feeds Us* (New York: W. W. Norton & Company, 1991), 356. On the development of cross-country trucking networks, see Shane Hamilton's *Trucking Country*. Hamilton contends that New Deal agricultural policies led to a consumer attitude that valued inexpensive food no matter the human cost on the supplier side. "By relying on long-haul trucking to craft a low-price food economy on America's rural highways, agribusinesses cultivated the antistatist, antiunion ideologies that made post-New Deal capitalism palatable not only to Mike Parkhurst's anarcho-populist followers, but to the broad swatch of the American populace who came to demand 'always low prices' at the supermarket. [...] agribusinesses crafted a business model that promoted low consumer prices, low wages, and minimal government regulation as inherent social benefits." Shane Hamilton, *Trucking Country: The Road to America's Wal-Mart Economy* (Princeton: Princeton University Press, 2008), 5.

²⁸ The ever-iconoclastic Mike Davis called these famines "The Secret History of the Nineteenth Century," and argued that a "fatal meshing of extreme events between the world climate system and the late Victorian world economy" caused these famines. In Davis' mind, El Niño droughts were not sufficient to cause famines, but when the peoples affected by those droughts also became integrated into modern economies the result was the deaths of perhaps fifty million people and the creation of the "Third World." Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (New York: Verso, 2002), 6, 12.

strains, combined with chemical fertilizers and petro-fuels, meant that producing incredible amounts of food could be done easier than ever before.²⁹

Perhaps more crucial than improved technology, however, was the reconceptualization that foreign nations needed the United States' help to feed their peoples. Nick Cullather described how the Green Revolution typically is conceived as "the greatest success in the history of foreign aid since the Marshall Plan," but instead should be thought of as "the birth of a new type of international politics." Many U.S. leaders believed that a multitude of hungry peasants in Third World countries, particularly Asia, presented a threat to either foment communist uprisings or politically destabilize the region. Feeding these hungry mouths would not only head off those problems, but also help integrate Asia's population into the world economy.³⁰ The Green Revolution did not deliver on everything it promised, however. Though it might have been intended as a foreign aid solution that would put the entire Third World into the United States' camp by feeding a hungry world, the Green Revolution did nothing to change existing social imbalances. And a host of unexpected outcomes, like pesticides damaging both the environment and human health, meant that even its successes came with distinct failures.³¹ In short, the Green Revolution was no perfect solution and

²⁹ John Perkins considers this an historical moment exemplary of "the immense importance of agriculture in general and the cereal crops in particular to the shape of human culture and the security of nations." In considering "agriculture as a complex set of technologies that access natural resources to produce food," he further argued, "considerations of national security and foreign exchange were really important examples of an even broader concept: that wheat and people are two species that have evolved a complex codependency since their first major encounter in the Neolithic agricultural revolution." John H. Perkins, *Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War* (New York: Oxford University Press, 1997), vi, 4.

³⁰ Cullather argued the United States had three conflicting goals with Green Revolution: 1) "restore a putatively lost 'balance' between food supply and population"; 2) "modify the psychology of the peasant"; 3) use "rural reconstruction [as] a technique of nation-building." Nick Cullather, *The Hungry World: America's Cold War Battle Against Poverty in Asia* (Cambridge: Harvard University Press, 2010), ix, 7.

³¹ Angus Wright wrote about the death of Ramón González, a fictitious Mexico farm worker clearly meant to represent many unnamed peoples, caused by pesticides. Wright criticized what he called "the modern

perhaps what U.S. planners considered to be the problem (lack of food) was more a symptom of uneven development than the problem itself. No matter the problem, though, atomic agriculture did play a key role in increasing agricultural production.

Fundamentally, though not exclusively, agricultural research with atomic energy began with the use of radioisotope tracer atoms. A 14 June 1946 press release by President Truman boldly declared, “The first peacetime applications of the results of wartime atomic research becomes immediately possible with announcement today of availability of radioisotopes for biological and medical research.”³² Even though less than a year had passed since the August 1945 bombings of Hiroshima and Nagasaki and the United States represented the only nuclear power in the world, Truman’s administration already had begun to promote atomic energy as a peaceful entity. Produced from the “atom pile,” radioisotopes offered scientists the ability to use “tagged” atoms—radioactive versions of common elements—to track how these atoms moved through biological processes, ecosystems, or anything else through which elements moved. Applying the tracers to agriculture seemed quite logical and, as President Truman expressed, would revolutionize biological research. The results from radioisotope research caused policymakers to champion the atom as a true boon to agriculture.

agricultural dilemma” and wrote argued “the social and ecological conditions of the countries of the South tended to magnify rapidly the ill effects of dangerous pesticides.” In short, “When the growth of a technology seems immune to the consequences of disastrous experience and the invention of inexpensive and effective alternatives, we have to begin to ask why.” And with a Marxist analysis, he pondered, “Persistence of dangerous technologies may also be based on severe social imbalances that allow hazardous technologies to prevail because the pattern of rewards and penalties associated with the technology is rooted in the distribution of power in the society.” Angus Wright, *The Death of Ramón González: The Modern Agricultural Dilemma* (Austin: University of Texas Press, 1990), xi, xiv-xv.

³² HSTL, Papers of Truman, President’s Secretary’s Files, Box 174, Folder Atomic Bomb, Press Releases [2 of 3], Press Release “First Peacetime Application of Atomic Research Becomes Immediately Possible under Army Program,” 14 June 1946

David Lilienthal, Chairman of the AEC, continued the President's tone of progress when he gave a speech titled "Atomic Energy is Your Business," sponsored by the Civic Organizations of Crawfordsville, Indiana on 22 September 1947. Lilienthal previously served as the head of the Tennessee Valley Authority, and therefore it is no surprise that he publicly held a collectivist stance when it came to the benefits of atomic energy. As the speech's title indicated, Lilienthal's first goal on that Monday evening was to contradict the notion that atomic energy was none of the U.S. public's business, as Lilienthal considered such a stance, "plain nonsense, and dangerous nonsense, dangerous to cherished American institutions and for that reason dangerous to national security." He also stressed that atomic energy and science did not change the "fundamental principles of democracy" and made the point that "atomic energy and atomic bombs are not synonymous."³³ To Lilienthal, the newly acquired powers from atomic energy, be these violent or peaceful, did not change the nation at all, and in fact the United State's new nuclear capabilities should be made to conform with the nation's already-present ideals with little change to the crucial ideas that made up the country's identity. New atomic understandings may have meant progress and the promise of a better future, but the good times ahead still aligned with bedrock U.S. principles and did not represent a rupture in U.S. history. In this way, atomic energy's relationship to agriculture should be conceived as a supporting force and not as anything that changed farming's character.

Most of Lilienthal's speech, though, stressed to his audience the benign possibilities for nuclear energy. He reminded his listeners that the sun is an "atomic energy factory," and continued, "Atomic energy is not just another new gadget, nor just a

³³ Underlining present in the original speech. HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy is Your Business, 22 September 1947, 1-3.

new weapon, however powerful and devastating. We are dealing with forces as fundamental to your life as the force of the sun, the forces of gravity, the forces of magnetism.” By comparing splitting the atom to the processes of the sun, Lilienthal turned harnessing atomic forces from something dangerous and arcane into something natural and common that his audience dealt with every day.³⁴ Nuclear energy was not new, dangerous and full of peril, but instead similar to a warm sunbeam on your face or any other natural force that humans could bend to their will for benefit.³⁵

Even if Lilienthal did not want his audience to consider splitting the atom new or dangerous, he still emphasized that atomic energy could produce incredible advances and throw “a clear light upon some of the oldest mysteries of life.” For example, humans could now answer the question of “how does a stalk of growing corn use the rays of the sun to manufacture its products into energy-giving food substances?” Agriculture, and its relationship to the sun, explained why atomic energy affected national destiny and buttressed the principles on which patriots built the United States.³⁶ In this way, Lilienthal’s rhetoric showed that improving agriculture through atomic energy clearly served the dual purposes of both agricultural and national improvement. Ideas about agriculture helped to express to his audience that nuclear research was important, natural,

³⁴ Lilienthal made this comparison even though a sun is powered by nuclear fusion and the chain reactions humans could create were nuclear fission. A similar comparison was made here: HSTL, Papers of Truman, President’s Secretary’s Files, Box 194, Folder ABomb War Department, Atomic Energy Source of Inexhaustible Power

³⁵ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy is Your Business, 22 September 1947, 4-5.

³⁶ Particularly, Lilienthal claimed that engineering knowledge was not needed to make decisions about the atom, but instead “What is needed is sense about human relations, about standards of fairness, about principles of self-government and of self-education” so that “petty politics” would not get in the way of progress. HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy is Your Business, 22 September 1947, 5-9.

and should continue. Perhaps most importantly, that research did not have to be associated with nuclear weapons in any way.

In addition, popular notions about technology's rightful place in agriculture served as an undercurrent to Lilienthal's speech and undergirded his contention that nuclear energy could play an important role in agriculture. Historian Donald Worster wrote that for agriculture around the turn of the twentieth century, the "most important new wrinkle was the machine."³⁷ From John Deere's metal plow in the middle of the nineteenth century to Henry Ford's automobiles, trucks, and tractors, agriculture received a significant technological boost in the century before Lilienthal's speech causing productivity to soar and prices to drop. Thus when Lilienthal's audience received the good word about the atom, they likely readily accepted the idea that technology fit into agriculture like sunshine and good weather. If the atom could provide the newest piece of equipment for farmers, it should be welcomed with open arms. David Lilienthal gave another speech that year worth noting, this one before the Annual Meeting of the American Farm Bureau Federation.

In his Farm Bureau speech, Lilienthal much more explicitly connected the atom to agriculture and showed the AEC's commitment to improving agriculture, implicitly showing how important agriculture was to the AEC's research agenda. On the afternoon of 16 December 1947, the AEC Commissioner offered the Chicago-gathered Farm Bureau Federation crowd advice as to why they should care about atomic energy. He explained, as his number one point, "No one in this country has a greater stake in the vigorous development of atomic energy, and the consequent increase in knowledge of the

³⁷ Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979), 87.

fundamental laws of Nature, than you who day after day work most closely with nature – the farmers of America.” Since he thought farmers had such a high stake in atomic development, Lilienthal’s second point followed closely when he contended that farmers needed to stay informed of atomic energy discoveries and peaceful uses of the atom.³⁸

With the speech, Lilienthal, and by extension the AEC, had several goals and all of these related to atomic boosterism through agriculture. Other than his stated goals above, Lilienthal also echoed his earlier desire to distance atomic energy from atomic bombs in the minds of his audience members. He declared a “myth” existed that atomic energy could only be used as a bomb or as a weapon, but instead argued, “Nothing could be farther from the truth,” and that now a “new world of knowledge” had opened.

Lilienthal further explained that treating atomic energy and atomic weapons as linked would cause the United States “to fall into an even deeper pit of error. We will grow forgetful of the true sources of America’s strength.” For Lilienthal, in implicit contrast to the Soviets, the U.S. got its strength not just from its military prowess, “but rather in the spirit of this nation, in the faiths we cherish.” He particularly cited faith in God and “a deep sense of stewardship to our Creator, the Father of us all; and when that is no longer strong within us we are weak and we are lost, however heavily armed with weapons – even with atomic weapons – we may be.”³⁹ Instead of war mongering, with this speech Lilienthal wanted to stress that atomic forces were “fundamental,” comparable to gravity and magnetism and could be harnessed as such. Anything that perpetuated the myth

³⁸ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy and the American Farmer, 16 December 1947, 1.

³⁹ All underlining is original. HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy and the American Farmer, 16 December 1947, 1-4.

conflating the atom with military might would, in his opinion, only work to deprive “you and yours of the peaceful fruits of this discovery” and even go against the will of God.⁴⁰

Not until page six of his speech did Lilienthal get back to his main point “that the farmer and the farm family have a very special stake in the wise and vigorous development of the science of the nucleus of the atom, for peaceful purposes.” He even compared the incredible stores of atomic energy to farm energy, saying, “the energies that produce great poems, that build churches and homes, the energies from which spring such noble ideas as our Constitution and Bill of Rights. That energy has been stored up in the plants of the field, and in the tissues of the animals that feed on your pastures; thence it comes to men.” Farms had produced food from the atomic energy of the sun for millennia, and farmers represented “the trustee and steward of that never-ending miracle by which the atomic energy of the sun becomes chemical energy and then human energy.”⁴¹ With this reasoning, farmers held an important stake in the development of atomic energy and its application. Farmers made possible all the United States’ great history and ideas by nourishing the bodies that produced these marvels, and the country needed them to help continue this great legacy. Moreover, the AEC needed farmers, the trustees and stewards of the sun’s atomic forces, to help support its atomic energy research agenda.

⁴⁰ The religious undertones were not uncommon at the time, either. In January 1951, one concerned citizen wrote to “Mrs. ‘First Lady’” to protest nuclear tests in the desert as being against divine plan. “This area which is chosen for the sake of proving the effectiveness of atomic destruction, was created by God to demonstrate to man the miraculous power of construction. Proof of this fact is God’s Law, which says: ‘The desert shall bud and blossom as the rose’.” The civilian also wrote, “May I add: that you secure about 2 bushels of desert top sand from Nevada and I will gladly show you how to have most beautiful flowers,” and claimed that, with more nuclear tests, “Our farm problems are most serious now.” HSTL, Papers of Harry S. Truman, Official File, Box 1524, Folder 692-Misc. (1950-53), Letter Hamilton L. Roe to Mrs. H. S. Truman, 12 January 1951

⁴¹ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy and the American Farmer, 16 December 1947, 2, 5-6.

To Lilienthal, the difference between “a modern American farm and a backward poverty-stricken farm” was knowledge, and “In this country the farmer has seen that the scientist is his partner, his companion and friend.” Lilienthal’s message held a clear implication—if providence (or the AEC) gave farmers, the “custodian of the sun’s energy and the forces of growth,” the opportunity to do something like develop nuclear power they surely would. The AEC Chairman gave the example of phosphorous to help explain why the wise farmer would want atomic science developed. He elaborated that, even though it cost a great amount, U.S. scientists could produce radioactive phosphorous. Phosphorous, like many other elements, gets taken up by plants during the growth process, but at the time agricultural knowledge had not advanced enough to know exactly what the plant did with that phosphorous after the chemical’s uptake. By using tagged radio-phosphorous, scientists could help “in a way never before possible chart the changes that occur in matter in the process of plant life and growth. In your behalf, the researcher can gain new and important knowledge of how plants convert the sun’s energy into life energy on this planet.” Clearly this represented the farmer’s “big stake” in nuclear development.⁴² Since scientists worked on the behalf of farmers, per Lilienthal’s own words, it seemed only logical that farmers would support their efforts, as supporting scientists truly was, in effect, supporting themselves.

Near the end of his speech, Lilienthal brushed aside any concerns his audience might have had over exactly what the uses of the atom in agriculture might be, encouraging that the breakthroughs would be significant. He reminded them that many prominent scientists, like Gregor Mendel, had been unsure of what their research might

⁴² HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy and the American Farmer, 16 December 1947, 6, 9, 11, 12.

mean when they began, though that research eventually proved fundamental to farmers. Lilienthal noted that harnessing the atom might also improve agriculture through pest control, pointing to an upcoming conference on the subject at Alabama Polytech at Auburn (today Auburn University). And while radiation might not be useful directly as fertilizer or in foods (though research would continue on this subject), agricultural improvement remained “one of the glorious promises of atomic science. It well may help to solve one of the most vexing problems of humanity – how to keep food production in pace with the growth of the world’s population.” With this flourish, and with a reminder that farmers needed to endorse atomic research, Lilienthal ended his speech. He claimed, “Trained as are no other group of men in the discipline of understanding and working with and through natural forces, endowed by the very nature of your calling with both persistence and patience, you American farmers are uniquely qualified to play a leading part in realizing the beneficial possibilities of this new force.”⁴³ Thus farmers, using atomic agriculture, would play a pivotal part in U.S. foreign aid plans in the future as the United States reconceived of its world role as helping poor, underdeveloped, and hungry countries become modern, fed, and prosperous nations.⁴⁴

Lilienthal did not stand alone in his ideas about the importance of farmers and indeed federal focus mirrored such notions. Historian Jenny Barker-Devine noted that that campaigns by many federal agencies used rhetoric that “placed farmers and rural residents on the front lines of the Cold War,” in contrast to these peoples’ typical moral and geographical distance from urban centers that were most likely to experience nuclear attack. Though focused on inculcating rural people into civil defense networks, especially

⁴³ HSTL, Papers of Clark Clifford, Subject File, 1945-54, Box 1, Folder Atomic Energy--Lilienthal, Atomic Energy and the American Farmer, 16 December 1947, 13-16.

⁴⁴ Cullather, *The Hungry World*, 4.

for urbanites fleeing potential nuclear attacks, Barker-Divine showed that much rhetoric coming from U.S. administrators described farmers as being essential to the Cold War effort, both for the agricultural products they produced and the moral bedrock they provided. And as the danger of radioactive fallout caused fear that rural areas too might be subject to danger (from that fallout), distributing scientific information to rural communities became even more important. Barker-Divine further explained that rural civil defense promoters used scientific boosterism “to foster positive attitudes toward family and farm preparedness, though much of the published literature and information in the media ultimately proved somewhat superficial.”⁴⁵ Farmers played a crucial role in the development of the atom rhetorically, and this chapter shows the importance of agriculture in nuclear development more directly.

With its lofty claims, Lilienthal’s speech served as a harbinger of future AEC emphasis on agriculture. Lilienthal’s speeches are like the loveable Dagwood anecdote from the beginning of this chapter—important because they are emblematic of how AEC officials thought about atomic agriculture and its place in the United States. The Commission put significant resources into researching how atomic energy and its products might improve agriculture and had great hope for the results their new technology might bring. The AEC also counted on agricultural development via atomic energy to help distance some atomic research from atomic weapons—as Lilienthal worked so hard to say in his two speeches, the two were not inseparable. The Commission also showed a focus on agriculture in its reports to Congress, and the January 1949 report showed the Commission had an emphasis on studying both how

⁴⁵ Jenny Barker-Devine, “‘Mightier Than Missiles’: The Rhetoric of Civil Defense for Rural American Families, 1950-1970. *Agricultural History*, Vol. 80, No. 4 (Autumn, 2006), 415, 432.

living creatures absorb radiation and also using radioactive tracer atoms to follow life processes.

That report asked, “Does Radiation Stimulate Plant Growth?” and showed an AEC commitment to harnessing the atom on a very blunt force level to improve agriculture. Even though David Lilienthal warned farmers in 1947 that radiation would not be useful as fertilizer, during the 1948 growing season the AEC supported experiments in fourteen states on nineteen different crops to see if radiation could be used successfully to boost plant growth. Unsurprisingly, the experimenters did not prove effective in using radiation to induce plant growth, but nevertheless the AEC planned more experiments for 1949. The report clearly stated, however, that such experiments were “quite separate and distinct” from other experiments into using radioactive isotopes to better understand plant growth—experiments on “the rate and volume of movement of various fertilizer materials in the soil, their absorption into the plants, and their accumulation in plant parts.” The Commission expected such studies would “solve practical problems of fertilizer application which are of direct dollars-and-cents interest to farmers, fertilizer producers, and farm machinery manufacturers.”⁴⁶ Even if radiation did not work as a fertilizer itself, research using radioactive isotopes could make existing fertilizers work better and unequivocally save farmers, and through them the rest of the nation, money.

The July 1949 report further espoused the AEC’s research plan regarding agriculture and portrayed improving agriculture as one of the Commission’s goals. In a section on “Radiation and Life,” the Commission described all of the ways that humans had learned about radiation, peaceful and violent, helpful and harmful. The report

⁴⁶ *Fifth Semiannual Report of the Atomic Energy Commission, January 1949*, 90-91.

explained, “Radiation attacks, disrupts, and destroys the delicate electro-chemical balance in the atoms, molecules, and protein combinations within the bodies of living things. As a result, it damages and kills the cells of which atoms and molecules are a part. If enough cells are destroyed, the whole organism—plant, animal, man—is severely injured or dies.” Curiously, though, the AEC continued its program on radioactive fertilizers. It is unclear where the logical disconnect occurred. Clearly knowledge existed that radiation harmed living things, but somehow this fact did not manifest itself in the cognizance that radiation might not be successful as a fertilizer. Researchers tested the same crops as in 1948 and still found no beneficial effects. The AEC also ran agricultural experiments on studying cattle exposed to radioactive fallout dust, understanding how fertilizers feed into plants, and many other smaller programs such as studying photosynthesis, mineral nutrition, and improving fungicides and herbicides.⁴⁷

To help meet its goal of improving agriculture, in the latter half of 1949 the AEC expanded its programs that studied the effects of “atomic energy and its products” on plants and animals, both in AEC installations and at the various colleges and universities through which it contracted. Not all of this research centered on agriculture. For example, at the Hanford plant, sited on the Columbia River in Washington, researchers determined that some organisms, such as plankton, could tolerate radiation much better than could other animals, such as humans. In the field of agriculture, specifically, research continued on how plants take in and utilize fertilizers, a program that the planners hoped could “mean a saving of thousands of dollars to the farmers of the country.” Specifically, researchers determined that crops use certain forms of phosphate better than others and

⁴⁷ *Sixth Semiannual Report of the Atomic Energy Commission, July 1949*, 18, 21, 101, 104.

that soil acidity plays an important role in how certain crops process that nutrient.⁴⁸ In addition to research aims and successes, the AEC and others frequently espoused how research into atomic agriculture actually saved money. Put bluntly, research was and is an expensive endeavor, and therefore the AEC found it beneficial to justify its sizeable expenditures. Any program that could claim to pay for itself in savings passed directly onto the taxpayers would be much easier to justify.

Somewhat surprisingly, research continued into the possibility of using radiation as a growth stimulant or fertilizer, which showed a deep commitment to atomic agriculture. In 1950 the Commission reported that too much radiation could slow tomato plant growth. Its studies found that if tomatoes received 20,000 roentgens total at a rate of 150 an hour, the plants would suffer ill effects.⁴⁹ The next AEC report clarified the seemingly commonsense (even then) position that radiation would hurt plants: “Experiments gave no indication that radiation could improve growth rate or yield, but in large doses caused marked damage to both.”⁵⁰ The desire to demonstrate that radiation itself could be beneficial to life forms had proved so strong that the Commission continued research into programs that, as AEC Chairman David Lilienthal had stated publicly in 1947, seemed pointless.⁵¹ Fortunately for taxpayers, not all AEC-supported research proved so fruitless.

⁴⁸ *Seventh Semiannual Report of the Atomic Energy Commission, January 1950, 21-23.*

⁴⁹ *Eighth Semiannual Report of the Atomic Energy Commission, July 1950, 172.*

⁵⁰ *Ninth Semiannual Report of the Atomic Energy Commission, January 1951, 24.*

⁵¹ In general, the AEC tried to downplay any potential dangers of nuclear energy, especially radiation. An October 1950 pamphlet on “Survival Under Atomic Attack” contained a section on “Kill the Myths.” Those “wrong” myths were, (1) “Atomic weapons will not destroy the earth”; (2) “Doubling bomb power does not double destruction”; (3) “Radioactivity is not the bomb’s greatest threat”; (4) “Radiation sickness is not always fatal.” In general, there existed an emphasis on downplaying the threat of atomic energy, especially radiation. HSTL, Papers of Harry S. Truman, Official File, Box 1527, Folder OF 692-A, Atomic Bomb, Survival Under Atomic Attack, 29 October 1950

Use of radioisotope tracers continued to form a crucial component of the Commission's research and helped the AEC show how atomic products were not inherently hazardous. For example, research delved into how cattle interacted with their environment, particularly how the ruminants broke down feed and converted that to milk. Other investigations used radioiodine to study plant growth regulators and also looked into mealybugs and how the critters affect pineapple plants, using radioisotopes to study the salivary secretions of the pests. Research even tested radioactive weed killers to determine how plants interacted with the chemicals. Further studies used radioisotopes to look at how plants absorb nutrients into their roots, transport them throughout the plants themselves, and then deposit those nutrients in the various plant structures.⁵²

Radioisotope research proved diverse and robust, and the AEC continued its research programs in 1951. That year agriculture and animal husbandry research advanced especially on the subjects of the metabolism of cows, fertilizers, and plant nutrition.⁵³

These programs show the thinking behind AEC decisions and how research frequently proved important for its own sake. Sometimes projects had specific foci, such as when the scientists attacked the mealybug problem. Many other times, though, researchers worked to know more about biology and plant physiology. While uncovering exactly how plants absorbed and transported nutrients had some direct applications to fertilizer use, the AEC supported such research to improve agricultural knowledge in general. The January 1952 AEC report to Congress contained the largest section yet on the atom and agriculture, with dozens of pages under the heading, "Atomic Energy and

⁵² *Ninth Semiannual Report of the Atomic Energy Commission, January 1951*, 24-25, 28.

⁵³ *Tenth Semiannual Report of the Atomic Energy Commission, July 1951*, 42-44.

Its Applications in Plant Science,” which helped explain the AEC’s research program and its goals.

Important for understanding the Commission’s motivations, the report claimed that there were two broad objectives in supporting research in plant science, one related to radiation safety and the other to directly improve agriculture as an industry. The first encompassed determining “the effects of radiation and radioactive products upon plants in order to broaden scientific understanding and to aid manufacturers and users of atomic energy in adopting measures to safeguard life and property.” In short, the AEC wanted to help humans be able to protect “crops and other property” from the damages radiation might present, as research “is necessary to cope with circumstances that may follow atomic explosions.” Focused on protecting the United States during an atomic bomb attack, knowing how plants and animals reacted to radiation exposure would be vital to the nation’s long-term survival. The second reason for studying the atom and agriculture was to “help in the application of atomic energy products and techniques to fundamental and applied research with plants” for the benefit of the United States’ people and industries. During the fiscal year that ended 30 June 1951, the AEC budgeted \$20.6 million on the entire field of biology and medicine, with \$1.3 million (over \$11.2 million in 2011 dollars⁵⁴) researching plant life.⁵⁵ While not the Commission’s primary focus, clearly the expenditure represented a significant emphasis on the matter.

The first research listed in that January 1952 AEC report focused on “Intense Radiation and Plant Development” and provided an endpoint to previous research. Different from past investigations, though, the AEC did not present this inquiry as any

⁵⁴ Inflation statistics cited from the inflation calculator on the U.S. Bureau of Labor Statistics’ Consumer Price Index website, here: http://www.bls.gov/data/inflation_calculator.htm Cited 3 February 2012.

⁵⁵ *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 69, 71, 75.

sort of fertilizer program. Instead, pertaining to objective one of the plant science research program, the research focused only on how radiation affected plant growth so that the Commission would know how plants might be affected after a nuclear blast. In general, the experiment produced mixed results. For example, on tested potatoes, some grew malformed, but others failed to sprout at all. Interestingly, these latter potatoes did not rot in the ground—irradiating the potatoes seemed to preserve them. This information would be important in the future. Fungi tended to better handle radiation than plants, so using radiation as a fungus control seemed impractical—dosing the undesired fungus with enough radiation to kill it would do more harm to the plants to be protected than to the attacking fungus.⁵⁶

Finally clearing up previous investigations into radiation being used as a fertilizer, the January 1952 AEC report stated, “Claims that radioactive fertilizers would increase crop yields have been discredited by repeated tests. Even small amounts of radioactive material used for ‘tracer’ research in plant studies may—unless care is taken—damage the plants and cause error in observed results.” The most obvious question is thus, “why did research into radioactive fertilizers continue for so long?” This question is made even more necessary considering the United States Department of Agriculture (USDA) had claimed in 1914 that radioactive fertilizers did not work. Nonetheless, further tests continued with USDA backing until 1944. And even though the USDA had discredited radioactive fertilizers decades before, agricultural scientists considered the question anew after the Hiroshima and Nagasaki bombings because observers claimed in the aftermath there had been “greatly increased crop yields” near the cities. In hindsight, though, it became clear that something else caused those bountiful harvests. In short, findings

⁵⁶ *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 75, 81.

showed that if radiation had any effects on plant growth, those effects would be negative, either killing the plant or stopping it from growing (or never growing in the first place).⁵⁷

At this point, the notion of radiation as a fertilizer seemed officially dead, but the fact that it held sway for as long as it did in research programs is important for what it says about the AEC as an organization and its goals. For political reasons, or perhaps merely to satisfy their own consciences, the idea that splitting the atom could and should be used for more than making war wove a common thread in both the Truman and Eisenhower presidencies (especially Eisenhower's with the "Atoms for Peace" program). Agriculture represented an easy way to show the benign effects of nuclear programs, and demonstrating that radiation was not a wholly bad entity seemed important in promoting the peaceful uses of atomic energy. Radiation, especially at high levels, breaks down living tissues. Thus while it may be put toward useful ends (such as in x-rays or for use as a radioactive tracer), in and of itself radiation does not present any beneficial qualities. The U.S. public knew that radiation represented a real threat to human health as well, especially after John Hersey's *New Yorker* articles turned into the book *Hiroshima* described in vivid detail the devastation wrought by the first atomic blast in Japan.⁵⁸ Clearly, then, research into ways that radiation, with no qualifications, might be a good and useful thing would have been important for policymakers. If decision makers could show that radiation had benefits or even could be healthy for some organisms in certain

⁵⁷ *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 82-83

⁵⁸ Not only did *Hiroshima* wake those in the United States atomic bombs' potentially horrific effects, it also presented the natural world as a counter to that destruction: "All day, people poured into Asano Park. This private estate was far enough away from the explosion so that its bamboos, pines, laurel, and maples were still alive, and the green place invited refugees—partly because they believed that if the Americans came back, they would bomb only buildings; partly because the foliage seemed a center of coolness and life, and the estate's exquisitely precise rock gardens, with their quiet pools and arching bridges, were very Japanese, normal, secure; and also partly (according to some who were there) because of an irresistible atavistic urge to hide under the leaves." John Hersey, *Hiroshima* (New York: Bantam Books, Inc., 1946, 1981), 46.

contexts, the moral position of creating radiation (such as in a nuclear bomb) would change dramatically. This helps explain why AEC research plans held onto the idea that radiation might function as a fertilizer so long after the USDA knew that it proved harmful to plants.

On the other hand, emphasizing the Commission's need to find peaceful and helpful aspects of atomic energy, the AEC chronicled radiation's harmful effects quite clearly. Beyond its obvious effects on living tissues, radiation also seemed to either kill soil microorganisms or make these much less effective. This could be especially damaging to plants if radiation killed the microorganisms around plant roots that help fix nitrogen—an element vital to plant growth. Also, the January 1952 report to Congress recognized strontium 90 (Sr^{90}), an isotope produced as fallout from nuclear explosions, as “potentially the most biologically hazardous of the fission products.”⁵⁹ In contrast to Sr^{90} , reactor cooling water seemed safe, as even though it has some radioactivity, most of that is either short lived or diluted, even if some might get absorbed by plants or algae. Effects on plants also depended on exposure, with those effects especially noticed in the growing sections of plants.⁶⁰

Research into how fallout radiation might harm U.S. agriculture also reflected a deep understanding of new geopolitical realities. In August 1949, the Soviet Union detonated its first nuclear weapon. This meant that the United States suddenly had to contend with another country unleashing an atomic blast upon it. With this new reality came a desire to know exactly how the nation might be affected. Agriculture formed a

⁵⁹ In biological processes, Sr^{90} mimics calcium and therefore plants readily draw in the fallout product. Once Sr^{90} enters plant tissues it then bioaccumulates as it meanders up the food chain and eventually gets passed onto humans, especially in cow's milk (the largest source of calcium in the human diet).

⁶⁰ *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 86-89, 92.

crucial part of that desire, and thus experimentation into what might happen to U.S. agriculture after nuclear attack—discerning how fallout and other radiation affected plants—became an even more important part of the U.S. atomic energy program.

Forays into the potential benefits of radiation did not end with the acknowledgement of its dangers, though, as the AEC worked to show how radiation could indeed be a positive force. The January 1952 report to Congress also stated, “Although fertilizers that depended on radioactivity for their action proved useless, radioactive tracers are showing how conventional fertilizers can be used more efficiently and economically.”⁶¹ Radioactive tracers helped scientists track nutrients through both whole ecosystems and individual plants, uncovering life processes as the radioactive elements made their way through biological cycles.

Also, studies on genetics and radiation spoke to this point and the AEC’s mission to better understand living beings through radiation. For example, inquiries found that corn exposed to less than five roentgen of radiation exhibited no appreciable effects, but exposure between 5-55 roentgen caused mutations proportional to the radiation dose. Mutations can occur naturally, and though some are beneficial an overwhelming majority end up being negative (at least from the perspective of the individual organism). If radiation could speed up the rate at which mutations occurred, in a controlled laboratory setting, beneficial mutations could be created, discovered, and isolated much more quickly than if humans left natural processes to their own devices. Radioisotopes also helped make possible research into tree and crop diseases, insecticides, herbicides, and photosynthesis.⁶²

⁶¹ *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 101.

⁶² *Eleventh Semiannual Report of the Atomic Energy Commission, January 1952*, 93, 95, 99, 101, 123-126.

As the Eisenhower presidency began, no great changes in agricultural research occurred from the AEC perspective, though a focus on peaceful uses of the atom increased. As the files from Eisenhower's 1952 presidential campaign show, developing atomic energy into a true industry formed an important part of Eisenhower's platform. Citing the need to both "improve the atomic arsenal" and continue "to probe the frontier of knowledge," soon-to-be President Eisenhower claimed during his 1952 campaign that nuclear energy should be viewed as past leaders had considered the steam and internal combustion engines. "Both of these opened vast new field in the development and application of energy and were considered by some to be so dangerous that their need should be carefully and rigidly controlled by government." Eisenhower cautioned against being afraid of advancing nuclear technology and instead explained that present decision makers needed to be as prescient as their predecessors support the development of this new technology, atomic energy, and all its beneficial advances. In this mindset, properly developing atomic energy certainly would create great developments in many fields, including agriculture.⁶³

These campaign speeches made sense in the context of an Eisenhower administration that tried to base agriculture much more on free market ideals than had his Democrat predecessors. Eisenhower selected Ezra Taft Benson for Secretary of Agriculture, and this represented a very conservative shift in policy. Benson believed that agricultural problems of the 1950s stemmed from overproduction by farmers in previous decades. The end result of Benson's policies, especially cutting holdover price floors from the 1930s, meant an incredible number of failed farms, as the number in the country

⁶³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Campaign Series, Box 6, Folder Atomic Energy, "General Principles Regarding Atomic Energy Development," 1-3.

dropped from 5.8 to 2.8 million. Edward and Frederick Schapsmeier claimed this happened due to “business failure, particularly among the small, inefficient operators.”⁶⁴ In hindsight, it is clear this occurred as part of a trend toward larger industrial farms and away from family farming (something Eisenhower surely would have supported in rhetoric as part of a Jeffersonian ideal, but obviously not in practice). Decisions during the Eisenhower era represented notions that agriculture should be considered a business, and atomic energy improving agricultural technology well fit a mantra later popularized by Richard Nixon’s Secretary of Agriculture Earl Butz, who famously quipped, “Get big or get out.”

With the nuclear industry and the threat of nuclear war in mind, the AEC sponsored investigations continued into how plants dealt with radiation. Those experiments studied how plants grew in soil containing concentrations of “fission products” (such as fallout like Sr^{90}) equal to the maximum fallout observed at nuclear blast sites. Growing radishes, barley, oats, cowpeas, and ryegrass, researchers found that strontium was indeed the radioactive element most likely to be absorbed by plants, but this occurred at a lower rate in soils rich with calcium (remember strontium and calcium function very similarly in biological processes). When cattle ate plants that contained radioactive fallout, cattle absorbed 25-30% of ingested strontium, with about 25% of that reaching the bone. This bone contamination would only be a hazard to humans if they ingested the bone splinters that might get into meat, though.⁶⁵ Other experiments

⁶⁴ Edward L. Schapsmeier and Frederick H. Schapsmeier, “Eisenhower and Agricultural Reform: Ike’s Farm Policy Legacy Appraised,” *American Journal of Economics and Sociology*, Vol. 51, No. 2 (Apr., 1992), 153.

⁶⁵ *Thirteenth Semiannual Report of the Atomic Energy Commission, January 1953*, 120.

measured how radiation sickness affected animals and used radioisotopes as tracers to study how tropical crops absorbed potassium.⁶⁶

A 1954 speech by Richard Bradfield, head of the Cornell University Department of Agronomy, emphasized the already present and growing importance of agriculture to atomic policymaking. Speaking at a New York meeting sponsored by the Atomic Industrial Forum, Inc., Bradfield started off his speech by remarking that the “value of radioactive forms of the various elements in agricultural research had been clearly demonstrated” long before the atomic bomb. While such research had been expensive in the past, the atomic pile made the generation of tracer isotopes less costly and therefore made research more feasible. The true purpose of the speech, though, was to “discuss some of the contributions which the atomic energy program has made to agriculture, particularly agricultural research.” Bradfield stated clearly, “In spite of our unprecedented increase in population, our agriculture has been able to keep up with our continuously expanding needs. It is now easily possible for ten percent of our population to produce all the food and fibre which our entire population needs. Probably never before in the history of the world have so few people fed so many so well.”⁶⁷ U.S. policymakers intended atomic advances of agriculture to ensure this trend remained realistic and also allow the United States to feed impoverished peoples around the world. Thus where just a few decades earlier during the Great Depression policymakers considered overproduction the problem, by the mid-1950s that overproduction meant prosperity at home through cheaper food prices and the ability to save lives and bolster world opinion of the United States abroad.

⁶⁶ *Fifteenth Semiannual Report of the Atomic Energy Commission, January 1954*, 46.

⁶⁷ DDEL, White House Central Files, Official File, Box 449, Folder 1, Atomic Energy and the Improvement of Agriculture, 12 January 1954, 1-2.

In fact, Bradfield asserted that dealing with surpluses represented the most pressing problem in current agriculture, a complete turnaround from most of human history. Agricultural surpluses, though, are obviously not the worst problem to have, as Bradfield claimed that plenty of food is important to both national security and peace. By referencing national security, Bradfield implicitly argued that agriculture was a part of keeping the United States safe and perhaps supplying food to the rest of the world could help bring peace. Agriculture thus transitioned from merely being the way we feed ourselves into being the way that the United States could help support geopolitical stability and set up itself as the leader of that new world order. Atomic agriculture could do this because radioactive tracers allowed a scientist “to follow the meanderings of his atoms” and ensure productive agriculture, defined by Bradfield as the combined product of good soil, varieties of crops being suited to environment (better seeds), and the reduction of the threat of plant diseases and insects (all of which could be improved by radioactive tracers).⁶⁸

Continuing this emphasis on productive agriculture, Bradfield reported that at least 30% of the recent increase in U.S. agricultural productivity had been from fertilizers, but continued, “we know that some of these fertilizers are not being utilized effectively.” In particular, phosphorous use in fertilizers was the culprit, and the country needed “wise use” of its phosphate reserves. USDA and Oak Ridge laboratories thus tested fertilizer intake by plants with radioactive phosphorous tracers. This enabled scientists to tell how much phosphorous came to a plant from fertilizer and how much came from the soil’s natural phosphorous. The experiments also enabled plant

⁶⁸ DDEL, White House Central Files, Official File, Box 449, Folder 1, Atomic Energy and the Improvement of Agriculture, 12 January 1954, 2-4.

physiologists to better understand the role of phosphorous in a plant's internal functions.⁶⁹

Bradfield also talked about the importance of some of the previous work on radiation and mutations so that his audience could further appreciate the gifts atomic energy provided agriculture. He explained that mutations are frequently useful to plant breeders, and “seem to be produced under natural conditions by radiations which reach the earth from outer space, the so-called cosmic rays.” But, as has been explained earlier, these do not occur very often and breeders frequently wish they could speed up these mutations—radioactive isotopes help speed up this process. The Gamma Field, located on Long Island near Brookhaven, represented the best example of this. There, radioactive cobalt got lowered into the ground by remote control when needed, and then researchers planted crops in concentric circles around the cobalt. Researchers studied the resulting crops, and “occasionally” one of the resulting mutations from exposure to the radioactive cobalt proved beneficial. Bradfield stated that already one promising crop, “a mutant of oats,” had been produced that “seems to have resistance to one of the most destructive diseases which attack this important crop.”⁷⁰ Thus Bradfield offered the mutant oats to the audience as proof that the experiments were worthwhile and successful.

Bradfield ended his speech by trying to dial back the enthusiasm for atomic agriculture a bit while emphasizing that any caveats did not diminish the benefits provided to the nation. He expressed that radioactive isotopes did not represent “a complete panacea for all the agricultural ills of the world.” And yet, they did have the

⁶⁹ DDEL, White House Central Files, Official File, Box 449, Folder 1, Atomic Energy and the Improvement of Agriculture, 12 January 1954, 5-6.

⁷⁰ DDEL, White House Central Files, Official File, Box 449, Folder 1, Atomic Energy and the Improvement of Agriculture, 12 January 1954, 6-7.

power to help scientists “unravel many of the mysteries which have so far eluded them. It will enable them to trace these elements from fertilizer to the soil, to the plant, and through the plant to the animal and then to man.”⁷¹ These closing remarks had a bit of a different tone than the rest of the speech. For several pages, the potential of atomic products to agriculture seemed incredible, at least in hypothetical terms. Moreover, Bradfield tied the future achievements of nuclear agriculture to the current state of agricultural surpluses, implicitly telling his audience that the true legacy of the described research would be to help make sure the nation remained well fed in the future. No matter how beneficial atomic agriculture had been to this point, only if their gains continued would programs be considered true successes. Even though Bradfield finished differently than he began, his speech still represented the idea that improving agriculture with the atom meant more than enhancing food production—it meant a policy decision about the security of the nation.

The AEC continued to support projects and research that reflected a position that atomic energy benefitted agriculture and by extension the nation. For example, the AEC reported in July 1954 on studies of how radiation affected plant growth and reproduction. It claimed an objective of testing “the feasibility of producing useful mutations by means of ionizing radiations in plants, shrubs, and trees normally propagated asexually.” These experiments produced several varieties of disease resistant plants. The AEC continued earlier experiments on irradiating potatoes as well, with the intention of determining what

⁷¹ DDEL, White House Central Files, Official File, Box 449, Folder 1, Atomic Energy and the Improvement of Agriculture, 12 January 1954, 7.

it takes to prevent these from spoiling.⁷² Another project studied calcium and magnesium content on twelve Wisconsin and Illinois farms in relation to how atoms got exchanged.⁷³

Public promotion of these atomic agricultural programs also continued, though not always in prominent places. In 1954 President Eisenhower received a personalized copy of “The Contribution of Atomic Energy to Agriculture and Medicine” from Carl Hinshaw (R-CA), a member of Congress’ Joint Committee on Atomic Energy Commission (JCAE). When thanking the Hinshaw for the book, the President said that he was “fascinated, as is everyone, by the potentialities of this great new era into which we are so rapidly moving.”⁷⁴ In that same year, James Hagerty, White House Secretary, communicated with organizers from the Toledo Council on World Affairs. Those organizers wanted to bring to Toledo, Ohio the atomic energy exhibit from Oak Ridge, Tennessee and arrange for 60,000 schoolchildren to attend it free of charge. One of the nine key points of that exhibit was “Atomic energy in the processing of feed and as it affects plants and domestic animals.”⁷⁵ It seems probable that the White House and AEC engaged in many other publicity activities, but the documentary record is not so full as to elucidate further. Most likely is that by the mid-1950s atomic agriculture still held importance in justifying the peaceful uses of the atom, but those who the AEC and White House wanted to know about atomic agriculture already knew enough to justify continued research. Atomic agriculture still served as a defense of atomic research for the

⁷² *Sixteenth Semiannual Report of the Atomic Energy Commission, July 1954*, 56-58.

⁷³ NACP, 326 Records of the Atomic Energy Commission, Entry 73, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953-6, Box 8
Folder USDA (Beltsville) – Soil Program (Sunshine), 1949-1957

⁷⁴ DDEL, White House Central Files, Official File, Box 449, Folder 5, Letter DDE to Carl Hinshaw, 3 September 1954

⁷⁵ DDEL, White House Central Files, Official File, Box 212, Folder 6, Letter Michael V. DiSalle to James Hagerty, 8 December 1954

benefit of humanity and by this point the larger public's blessing (other than from the JCAE via the AEC's reports to Congress) seemed less important.

AEC support of agricultural studies using radioisotopes continued to occupy a prominent role in justifying how those programs produced interrelated benefits for both atomic energy and agriculture. Experimenters paid particular attention to studying “the intake of radioactive materials” by livestock, including tissue distribution, absorption, retention, and excretion.⁷⁶ Intake by plants also received study. The AEC reported to Congress that “Knowledge of the effects of fission products on plant growth and reproduction is important in evaluating health and safety aspects of atomic tests and production operations of nuclear reactors.” In short, agriculture could help better understand the effects of atomic bombs, emphasizing that agricultural research helped more than agriculture. Research also confirmed that fallout products tended to act like other elements—strontium like calcium, cesium like sodium or potassium, etc. Other research, at North Carolina State College, used radioactive tracers to show that corn obtained about 70% of its nutrition from the top ten inches of soil and peanuts about 87% from the top ten inches. How nutrients get absorbed depended on the specific plant and its root distribution pattern.⁷⁷

Radioisotopes also could be used for much more than uncovering how plants absorbed nutrients and helped push atomic agriculture into new realms. The tracers also made possible inquiries into how a rubber plant produces its valuable product, and then enabled tracking that produced rubber to see how it broke down and degraded. In addition to tracers, experimentation continued into how plants absorbed fallout products.

⁷⁶ *Seventeenth Semiannual Report of the Atomic Energy Commission, January 1955*, 48.

⁷⁷ *Eighteenth Semiannual Report of the Atomic Energy Commission, July 1955*, 85-86.

The AEC also reported that the ratio of calcium (and thus strontium) plants absorbed seemed identical to the concentration of other chemicals (ammonium acetate in particular) in the soil in which the plants grew. Researchers continued to use radiation to produce mutations in plants, hopefully improving the crops, such as their physical characteristics and disease susceptibility. And if immunity could not be created to diseases or pests, then radiation might be used to control those pests. Research showed that nematode worms might be controlled by radiation, but of course too much radiation would prove injurious to the plants on which the worms feasted.⁷⁸

The boosterism of atomic energy in relation to agriculture continued in 1956 with the Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy. While technically a report in the legislative branch, Robert McKinney, former Assistant Secretary of the Interior under Truman, chaired the panel. The panel devoted chapter five of its report entirely to agriculture, and argued, “Peaceful uses of atomic energy in the field of agriculture are a significant addition to the many other modern methods of improving farm technology.” Not only did atomic agriculture mean “increased productivity and lower costs for individual farmers,” but the report also argued that improved agriculture also gave the U.S. a “dramatic opportunity to lead underdeveloped, undernourished nations to higher living standards.”⁷⁹ Only by sharing food production techniques with impoverished nations, by cultivating the Green Revolution, could U.S. planners safeguard the Third World from communist influence

⁷⁸ *Nineteenth Semiannual Report of the Atomic Energy Commission, January 1956*, 78-81.

⁷⁹ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation "Candor" (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 61.

and keep those nations secure from destabilizing influences. Hence, atomic agriculture could play a significant role in defining the United States' place in the world.⁸⁰

The ways the panel expected these incredible achievements to happen show another public expression of the national benefits provided by atomic agriculture. The panel hoped the power of the atom could help scientists learn more about life processes of the plants and animals in agriculture and how best to use fertilizers, insecticides, and medicines. Radioactive tracers did not necessarily make such research possible, but certainly made it much easier. The panel also reported that atomic agriculture could help breed new plant varieties that were better adapted to particular climates, soils, and rain patterns, while also being more resistant to diseases and “tailored to mechanized cultivation and harvesting.” Very much playing into notions of the Green Revolution, using the power of the atom would “add great impetus to the technological revolution in agriculture.” In short, readers should “expect higher farm output, more flexibility as to the crops and animals produced, and ultimately more varied diets at lower costs.”⁸¹ Language like that made harnessing the atom in agriculture not only a foolproof way to improve the nation's resources—a way one would have to be foolish not to support—but also became a moral imperative for helping to improve the world.

Plant breeding offered one specific way to accomplish these lofty goals and a provided dramatic expression of how radiation could be a good thing for living beings just as the AEC had hoped earlier experiments into radiation fertilizers would. Scientists

⁸⁰ As Nick Cullather explained, the Green Revolution led to a new type of international politics: “How and on what terms Asia's population would be integrated into the world economy, whether fragile postcolonial states could extend mechanisms of taxation and authority over vast ungoverned hinterlands, and whether poverty on this scale even could be ameliorated were all questions that lay outside of the customary conventions of international relations.” Cullather, *The Hungry World*, 3-4.

⁸¹ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation “Candor” (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 61.

could do this by using atomic energy “to speed the evolution process.” This implied that radiation mutations were not unnatural, but instead merely helping natural forces work a little faster than these might on their own. Exposing plants, animals, or insects to radiation made it possible to create new plant varieties or varieties more quickly and replace natural selection with human choices. The report further explained that only a small percentage of the new “variations” would be good, and scientists still had to winnow these from the unhelpful ones so they could be “put to work on the farm.” The report closed the section by boldly claiming, “At least on a laboratory scale, the day of the tailor-made plant seems close at hand.”⁸² Already on hand, though, was the day of using hopes for the atom in agriculture to push research agendas.

Atomic boosterism caused the AEC to cast even seemingly negative experimental results, such as the development of new blights with increased virulence, in a positive light. The report claimed that the development of these new blights under controlled conditions allowed geneticists to breed plants resistant to the new pestilence, preparing the plants and farmers for these new blights before they appeared in the field.⁸³ Of course, such a statement assumes one of two things—either the blight created under laboratory conditions would at some point get out into the larger world and plague crops that way, or that natural selection and evolution are sure to produce the same or a similar disease on their own. Assuming the first (laboratory release) would not happen, any

⁸² Some useful variations had already been created using induced radiation mutations. Those listed were: (1) barley, “Dense heads, stiff straw, tall straw, higher yield of grain and straw”; (2) oats, “Earliness, higher yield, stem-rust resistance, short stems”; (3) wheat, “Stem-rust resistance, higher yield”; (4) corn, “Shorter or taller stalks, earlier or later ripening, resistance to lodging”; and (5) peanuts, “Leaf-spot resistance, higher yield”. DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation “Candor” (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 64.

⁸³ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation “Candor” (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 65.

assumption that the second would occur represents an understanding of evolution that is far too linear and progressive to be accurate (just because laboratory conditions produced one blight it does not mean that natural conditions ever would have).

Other parts of the report seem like science fiction, even in today's world. The report claimed that researchers could duplicate many of the steps involved in photosynthesis, meaning that a time was "within the realm of possibility" that humans would not depend on plants "to produce edible energy in the form of starches, sugars, fats and proteins," but this could instead be done chemically on a commercial scale. And if other boosterish claims were not so far fetched, they still presumed a great deal. For several pages the report made claims about how atomic energy would help produce more food on fewer acres at a lower cost. Since a "principal fact of the American way of life is that it is based on abundance," creating even more abundance with food would only enhance the lives of the nation's citizenry, as surely low food prices would stay low (how such production might hurt farmers went unmentioned). Again, the greatest problem the U.S. ran into with this line of reasoning was how to deal with all the agricultural surpluses that such research would surely help produce.⁸⁴ Historian Shane Hamilton has interpreted these surpluses (and the trucks used to transport the foodstuffs around the country) as aggressively undermining New Deal liberalism with free market solutions.⁸⁵ Whether this is true or not, policymakers did believe that if then current excessive

⁸⁴ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation "Candor" (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 65-67.

⁸⁵ Hamilton argued, "Trucks [...] were inherently political technologies, used by agribusinesses to craft 'free market' solutions to the farm problem while ironically allowing regressive New Deal farm policies to outlive the labor, consumer, and regulatory programs of the New Deal." Hamilton, *Trucking Country*, 7.

production meant consumer prosperity that even more food would lead to ever-lower prices on the shelves and improved lives of the nation's citizenry.

This report differed most significantly from other treatises on atomic agriculture in that it explicitly insisted this new knowledge and technology could help the United States feed the world, emphasizing a perception that the United States' role in the geopolitical realm had changed. It stated bluntly that the U.S. "can help the undernourished peoples of the world have more to eat" so long as more research, education, and work occurred, as there would be "no miracles" without these. The report finished with three recommendations: the United States needed to keep researching; those dealing with the farm surplus problem take into account that atomic developments will exacerbate the problem; and an exploration of the humanitarian benefits that could result should begin immediately. The third point held particular importance, as "Only in this way can the United States bring to bear atomic contributions to agriculture, so as to demonstrate our historic sense of international humanitarian leadership."⁸⁶ This particular sentiment likely proved particularly important as the U.S. sought to establish its place as a world leader in contrast to the Soviet Union. If the United States could help feed the world it would have a significant bargaining chip in the Cold War court of world public opinion. Thus agriculture, and by extension atomic agriculture, became fundamentally tied to a U.S. global imperative.

The AEC continued to use agriculture as a public demonstration of the benefits provided by atomic energy. In its 21 January 1956 issue, *Science News Letter* ran an

⁸⁶ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File Administrative Series, Box 9, Folder Operation "Candor" (1), Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, Volume 1, January 1956, 67-68.

article titled, “Atoms Vital to Agriculture.” That article cited Dr. Williard F. Libby, AEC Commissioner, as claiming that the U.S. economy may get “as a big a boost from the use of atomic energy in agriculture as it will from atom-generated electricity.” Though he did not provide any sort of timetable for when gains could be expected, Libby’s “low” estimate was a \$210 million per year benefit. In general, Libby propounded atomic benefits to agriculture in fertilizer studies, pest control, and preservation.⁸⁷ The article, thus, effectively served as an atomic booster and gave a broader audience to Libby’s voice, and by extension the AEC.

In July 1956, the Commission claimed that the radioisotopes used for research and production in industry and agriculture already repaid the U.S. “a dividend of several hundred millions a year” on monies invested. Of course, it added, that such focus on money ignored “the value to mankind of these substances as scientific tools, diagnosis, treatment and scientific study of human diseases and their consequent alleviation of human misery.”⁸⁸ Strangely, at the same time the AEC made such incredible claims as to the value of the atom in agriculture, its reports on agricultural research waned a bit. The January 1957 AEC report to Congress only reported on the use of radiation to inhibit photosynthesis as 100,000 roentgens of gamma radiation temporarily reduced that process in wheat to 25% of normal.⁸⁹ It is unclear how such research might have proved compatible with previously stated goals.

It did seem clear to AEC officials, however, that radioisotopes were of incredible use to the U.S. atomic energy program and the public needed to know that. A February 1957 AEC report prepared in advance of hearings by the Congressional Joint Committee

⁸⁷ “Atoms Vital to Agriculture,” *The Science News Letter*, Vol. 69, No. 3 (21 January 1956), 35.

⁸⁸ *Twentieth Semiannual Report of the Atomic Energy Commission, July 1956*, XI.

⁸⁹ *Twenty-First Semiannual Report of the Atomic Energy Commission, January 1957*, 80.

on Atomic Energy claimed that the estimated savings in agriculture by radioisotopes might reach \$210 million per year. The report did not, however, explain in very much detail how such an estimate had been measured or figured. It continued, "There is no reason to doubt the order or magnitude of these figures." As an example of this, the material estimated that radioisotopes saved the nation around \$500,000 to \$1 million per year in fertilizer studies, "based on spot checks." Moreover, the report emphasized that the knowledge gained in studies with radioisotopes needed to be passed onto state, federal, and country agricultural organizations, as ultimately farmers would need the findings for these to be of any real use. In short, "There is every reason to anticipate that when this translation can be accomplished and made available to the nation's farmers, the estimated potential savings of \$210 million per year can in a large measure be realized within the foreseeable future. Such savings could be reflected in an improved farm productivity at lower unit costs not only in this country but also in other nations."⁹⁰ The report clearly implicated that if only the knowledge gained by scientists with the help of radioisotopes could be put in the hands of farmers, the nation would become even more prosperous.

At this point, much of the research intended to eventually help farmers, at least as conveyed to the public by the AEC, was lists of the previously known ways that atomic energy could improve agriculture. Reiterating the importance of radioisotopes and their use, the July 1957 report to Congress listed as the major benefits to agriculture:

(a) better placement and application of fertilizer, (b) new and improved growth regulators, herbicides, etc., (c) improved measures against plant diseases and fungi, (d) better knowledge of animal nutritional needs, (e) improved measures

⁹⁰ DDEL, White House Central Files, Official File, Box 453, Folder OF 108-F Atoms For Peace (5), Material prepared for hearings by the Congressional Joint Committee on Atomic Energy, February 1957, 1-2, 13-14, 20.

against animal diseases, (f) better insect control through sterilization, insecticides, and information on migration and hibernation, and (g) new or improved varieties of plants and breeds of animals.

In fact, these benefits had proved so valuable that agricultural use, in conjunction with use by medicine and industry, had created such demand for radioisotopes that demand had begun to exceed supply.⁹¹

One new avenue of research pursued by the AEC centered on irradiating seeds and crops to produce beneficial effects and continued the theme of searching for positive benefits of radiation. Just as earlier research had accidentally discovered with potatoes, irradiating, if done at proper levels, could significantly improve the storage of agricultural products. Too much irradiation, though, could be harmful to seeds. Some research even found that after seeds had been irradiated, stored, and then planted, radiation damage could increase by as much as a factor of three than if scientists only irradiated and planted them. Water, oxygen, and heat exposure before and after irradiation also affected how seeds performed.⁹²

This is not to say that previous avenues of research did not continue as part of the AEC's plan to improve the nation through atomic agriculture. Emphasis on radioisotopes and the amount they saved the nation continued, with special attention paid to the gains made in "broadened knowledge and improved management" of both crops and livestock, including a greater control over the diseases and pests that afflicted both. Better fertilizer use and improved insecticides and herbicides also derived from research, with "benefits

⁹¹ *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 29, 32-33.

⁹² *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957*, 116-117.

in sight from widening experiment with plants and animals.”⁹³ The January 1958 report later elaborated that researchers made these gains with “essentially a byproduct of atomic energy activities—the radioactive isotopes of the natural elements created in nuclear reactors.” Radioisotopes also helped scientists create soil moisture and density gauges, useful in both agricultural and industrial processes.⁹⁴

Even when not explicitly focused on improving agriculture, AEC research frequently found grounding in it. Other projects focused on “the impact of various atomic energy activities on *man’s environment*.” The AEC intended these studies to better understand “the balance” between all life forms, whether they live in land or water habitats. The report claimed that the answers gained would assist decisions about the extent to which agriculture, and other atomic energy activities, “may occupy an area and lead to general benefit rather than detriment.”⁹⁵ More direct inquiry into agriculture continued as well.

Significant research in livestock and insecticides persisted, especially in using radioisotopes to track biological processes in the studied creatures. Such research continued to provide a public display of the atom’s gifts to agriculture. For example, using radioisotopes, scientists uncovered that some fatty acids absorbed by cattle in their digestion are used to form milk sugar lactose, while others are used principally to make butter fat. Researchers uncovered other technical information about digestion as well. In general, studies tagged parts of a cow’s feed and then traced those bits to see how cows

⁹³ The AEC claimed that in saving about \$500 million per year, radioisotopes produced a better than 7% yearly return on the \$7 billion spend on them in taxpayer money. *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 4.

⁹⁴ The soil moisture gauges worked, in layman’s terms, by zipping radiation into the soil and then measuring what got reflected back into the gauge. *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 26-30.

⁹⁵ Italics are in the original. *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 36.

transformed feed into milk. For insecticides, by using radioactive tracers, scientists determined not only exactly how pesticides affect pests, but also how much toxic residue made it into and onto raw agricultural commodities. Experiments also successfully led to the eradication of the screwworm fly in controlled tests on the island of Curacao in the West Indies. Since screwworm flies caused damage to Southeast livestock of around \$10 million a year, finding a way to combat them seemed important. Radioisotopes also helped provide insight into how herbicides affected plant growth regulators, helping scientists study the agricultural chemicals 2,4-D and 2,4,5-T.⁹⁶ However, the most heavily pushed research occurring at the time related not to using radioisotopes, but instead to using radiation to change the composition of foodstuffs.

In contrast to early efforts with using radiation as a fertilizer, irradiating foods and seeds at precise levels did seem to have real benefits and at the end of the decade occupied much of the ink received by atomic agriculture. This is not to say older sorts of experiments (such as using radioisotope tracers to trace how nutrients travel through plants' leaves, stems, and fruits) disappeared entirely, but irradiating plants became much more important. Previous experiments had used radiation to create beneficial mutations, and the AEC reported, "beneficial mutations are being found in sufficiently high numbers to justify continuing efforts."⁹⁷ The most exciting and prominent gains of the time through irradiating plants and foodstuffs, though, came in the form of food and seed preservation.

⁹⁶ These two chemicals, in conjunction, formed the active ingredients in the infamous Agent Orange used so profusely during the Vietnam War. *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 57-63.

⁹⁷ The January 1958 AEC report to Congress listed some of the particularly beneficial mutations derived from mutations to be disease resistant strains in wheat, oats, and flax, and high-yield dwarf varieties that suffer from less wind damage. *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 64-67.

It is no surprise that the AEC moved toward development of irradiated agriculture because such a program well fit the Commission's goals of benefitting agriculture and the nation and using atomic energy to do it. On 25 February 1960, the Commissioners of the AEC met and discussed the establishment of a radiation processed food program. The Interdepartmental Committee on Radiation Preservation had proposed a conservative investigation into the potential of irradiated foods building upon a similar Army study from 1953. At that time, the Army performed experiments on twenty-six types of food, particularly focused on unrefrigerated preservation for up to a year. It found that only certain meats—beef, pork, poultry, and ham—fit the desired specifications.⁹⁸ Thus while atomic agriculture could serve the national security mission by feeding a hungry world, it also could enable the U.S. military to conduct even longer troop deployments than previously. If “an army marches on its stomach,” then having food that would last for a year without refrigeration might keep soldiers marching for a long time if they were cut off from supply routes.

Though the Army program certainly found some success, there had been no testing on civilian foods as such would have been out of the military's purview. The Commissioners, however, decided that the AEC should support the Interdepartmental Committee's program so that civilian food could be tested. More than seeking to fill a hole in a research program, though, the AEC thought the food irradiation program fit the AEC's mission (along with the Atoms for Peace program) of finding peaceful applications of atomic energy and also made sense for the AEC to pursue because of its “unique knowledge and competence” concerning the involved technology. The Army had

⁹⁸ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1595, 25 February 1960, 152-153.

experienced storage and logistical issues with their irradiated foods, especially related to bacterial contamination of foods irradiated at high levels and then stored for extended periods. Canning had been necessary to solve this problem, but discussions did not seem to find this a particular problem for future AEC experiments. Eventually John McCone, the AEC Chairman, declared that the program “held promise for revolutionary developments for the food industries of the world.” The Commission then approved \$115,000 in their budget for research in fiscal year 1960, with \$500,000 planned for the fiscal year 1961 budget.⁹⁹

About a month after that meeting of the AEC Commissioners, the AEC made its plans public when the Research and Development Subcommittee of the JCAE held a hearing on a food irradiation program. At that hearing, Richard Morse, Director of the Army Research and Development program, presented the Army’s revised research program on preserving food through irradiation. This program had seemed sensible and been well received, but focused on high-level radiation sterilization and preserving food for a year. In contrast, the AEC’s civilian program would emphasize low-dose “pasteurization” to extend the shelf life of perishable foods—civilians did not necessarily need meat that could sit in their pantry for a year at a time, but having fruits and vegetables stay fresh longer before spoiling would have been a nice benefit. After debating whether the level of funding assigned truly was appropriate (deemed it was), the one snag in the Commissioners’ plan seemed to be that low-dose radiation might not be commercially available for 5-10 more years. This seemed not such a problem, though, to either the AEC or the Joint Committee. The Joint Committee wanted to push the

⁹⁹ McCone’s sentiments were paraphrased in the notes, and therefore it is unlikely that the wording is a direct quotation of his. NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1595, 25 February 1960, 153-154.

programs “because preservation of food by radiation was a dramatic program easily understood by the public.” The Commissioners agreed, and their only concern was how the program might appear to a public that had been promised rapid results—results that might be hard to deliver so quickly.¹⁰⁰ The AEC did not stand alone in a desire to show the world the benefits of irradiation.

After the AEC decided to support irradiation research, scientists conducting the research also had an interest in seeing those programs succeed. Because of this, Dr. C. J. Spears of Oak Ridge Atom Industries, Inc., asked President Eisenhower to take some of his company’s irradiated flower and vegetable seeds to plant on the President’s farm. Spears’ representative explained that doing so would “awaken the people of the U.S. further to the many benefits that have been afforded them as the result of the efforts of the Republican Party in promoting the peaceful uses of atomic energy.”¹⁰¹ As could be said for the program of using atomic energy to improve agriculture more broadly, irradiation of food and seeds meant more to its proponents than merely a way to better handle the nation’s food production.

By the end of Eisenhower’s second term, agriculture had deep roots as an important part of the nation’s atomic energy program. John McCone’s letter of resignation to Eisenhower just a few weeks before the end of Eisenhower’s presidency helps show this fact. McCone’s resignation letter included a statement titled “Eight Years of Progress in Atomic Energy,” and deemed the advancement of the nation’s nuclear programs “substantial.” In that statement, McCone addressed agriculture and its

¹⁰⁰ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1603, 1 April 1960, 221-223.

¹⁰¹ DDEL, White House Central Files, Official File, Cross Reference Sheets, Box 88, Folder OF 108 Atomic Energy 1960, Cross Reference Sheet, Memo for the Record, 24 June 1960

improvement, listing as successes radioisotope progress in fertilizers and weed killers, radiation in plant genetic improvement and pest control, and generally improved agriculture in general.¹⁰² Looking back at the end of his term as Chairman of the AEC, McCone counted atomic agriculture as one of the accomplishments of his tenure.

In the end, using atomic energy and its products to improve agriculture showed several things about the United States. First and most obviously, it functioned as a way to improve the nation's agriculture, even though the United States clearly did not suffer when it came to food production—far from it. By the 1950s, one of the most serious problems the nation's agriculturalists faced was how to deal with the incredible surpluses of food they already created. Therefore, helping the nation better produce greater amounts of food might have seemed inconsequential or even harmful. Yet atomic energy helped scientists uncover new ways to farm and raise livestock better, and this achievement proved important to policymakers. Also, those in power repurposed increased production as a way for the United States to feed a world that policymakers more and more conceived of as being filled with hungry people in need of U.S. aid (for both their own good and that of the United States). Particularly with radioisotope tracers that helped unlock many biological mysteries, U.S. agriculture harnessed the atom quite successfully. And yet using atomic energy did more than nobly ensure that food production passed “from trial-and-error to certainty” as the Dagwood cartoon claimed.

Perhaps even more important than its obvious purpose of improving farming, atomic agriculture functioned as an important way to show how splitting the atom could do more than unleash death and destruction. By emphasizing the peaceful applications of

¹⁰² DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Administrative Series, Box 5, Folder Atomic Energy Commission 1960-61, Letter McCone to Eisenhower, 3 January 1961

nuclear energy, programs that attempted to improve agriculture allowed the Atomic Energy Commission and the executive branch to say to the public, with good reason, that they desired peaceful applications of atomic energy. Clearly the first worldwide application of splitting the atom had been horrific—no matter your side during World War II, the bombings of Hiroshima and Nagasaki terrified almost everyone to some degree. But through agriculture, something fundamental to modern human existence, policymakers hoped to reclaim nuclear energy from its more sinister applications. Showing that using atomic energy could be peaceful dramatically changed the AEC's purpose and transformed the organization from death-bringing existence to one capable of great good. In this way, research into agriculture using atomic energy could be just as useful to the AEC as it was to fields and farms.

Atomic agriculture also opens a window into the perceived place of agriculture in both the United States and the world at the time. Agricultural modernization with mechanization and chemicals found its logical next step in atomic agriculture, as the atom truly only represented the newest technology that could be put to work for the good of farming. This let U.S. farmers produce their products ever more cheaply and efficiently, which meant that U.S. citizens got ever more bang for their buck in grocery stores, all while supporting the rise of agribusiness. Internationally, anxieties about feeding the world (necessitating increased food supplies) also meant that the United States could manufacture a new place for itself in the world—a role not only as world food supplier, but also as a distributor of knowledge proverbially teaching the world to fish rather than fishing for it. Both of these facets of food production—both at home and abroad—aided atomic agriculture in bolstering the nuclear complex and furthering its development,

which created a sort of feedback loop between the atom and agriculture. Supporting atomic research thus meant furthering agricultural modernization and the Green Revolution, and frequently the inverse of that held true as well as well.

Atomic agriculture also helps shed light into differences and similarities between the Truman and Eisenhower Presidencies. While Dwight Eisenhower is much better known for furthering non-military applications of atomic energy with his “Atoms for Peace” program, it is clear that policymakers during the Truman administration also intended the split atom for more than bombs. Truman’s 1946 proclamation about the importance of radioisotopes and AEC Chairman David Lilienthal’s 1947 speeches help show that Truman and his associates, even from early on in the atomic age, also wanted to support peaceful projects. The most significant difference between how the two programs related to atomic agriculture is that, very simply, knowledge about nuclear energy and agriculture was much more advanced during Eisenhower’s terms. Truman’s administration supported and furthered research until he left office in 1953, and this enabled Eisenhower to continue preexisting programs. In this case, the Eisenhower administration looks like the one more concerned about and with a better understanding of the environment—for example, nobody thought radiation might grow plants in 1955—but this phenomenon is not necessarily due to any superiority in the Republican presidency in relation to his Democrat counterpart’s.

While bomb improvement and production may not have stopped at any time during either presidency, as long as research into agriculture continued the United States could maintain a much more moral position. Not everyone believed in the idyllic ends that such programs might achieve—helping the United States feed the world. And yet,

not everyone had to believe that. No matter the exact end point, the benefits to researchers and farmers seemed obvious and the research did allow the United States to advance its nuclear program under peaceful pretenses. Fundamentally, atomic agriculture held dual purposes—agricultural improvement and the advancement of an argument that nuclear energy should be considered a benign entity and not a harbinger of death. This doubly purposed research means we need to revise not only our understanding of what atomic research meant for the environment during the Cold War, but also recognize that many organizations might be willing to improve the environment if it also means improving their own public image.

Chapter Five

From Affluence to Effluence: Nuclear Waste Disposal

In October 1947, Harvard University President J. B. Conant gave a speech entitled “The Atomic Age” at the National War College that focused on military matters, especially the idea of a “superblitz.” Near the end of that speech, however, Conant delivered a line that could almost be considered a “throwaway,” but one that nonetheless showed exactly what many decision makers thought about the eventual fate of radioactive materials. Discussing what to do when the world tried to rid itself of atomic weapons, Conant declared, “In the last stage all existing stocks of plutonium and U-235 [fissionable uranium] would be dumped into the sea or ‘denatured’ so that the material would not be available for atom bombs.”¹ Hypothetically, this sounded like a fine idea. As long as fissionable materials had been “denatured” so that the ores could not be used in atomic weapons, these posed no military threat to humans. The second option, depositing all nuclear materials in the ocean, meant humans avoided dangerous radiation for the most part. In reality, this sentiment ignored that denaturing did not constitute a perfect solution and also discounted some of the very real political, social, and ecological realities of dumping nuclear waste into the oceans.

Historian Jacob Darwin Hamblin has chronicled the political, scientific, and diplomatic maneuverings of nuclear nations dumping their nuclear waste into oceans in the second half of the twentieth century. At one time, humans saw the environment as “sublime, powerful, eternal, and inexhaustible.” However, the natural world “became in the twentieth century a fragile entity apparently drained of its resources and life—a

¹ Conant was former Harvard chemistry professor and at the time of this speech president of the university. HSTL, Papers of Clark Clifford, Box 41, Folder Conant, J.B. [“The Atomic Age,” a lecture at the National War College, October 2, 1947]

vulnerable earth greatly in need of protection or control.”² When it came to waste disposal, this meant that humans previously thought that “dilution is the solution to pollution” and dumped copious trash of all sorts into the seas because they believed an all-powerful natural world could not be harmed—the oceans simply were too big to ever become truly polluted. After the rise of environmentalism, in contrast, humans began to view the environment in much more cautious ways, and a new status quo considered the natural world as a delicate balance that needed to be protected.³ As Hamblin wrote, “In the 1950s, leading oceanographers viewed the ocean as a sewer, using language that might have led to the professional ostracism of an aspiring marine scientist just a couple of decades later.”⁴ Thoughts about nuclear waste disposal during the Truman and Eisenhower presidencies thus reflect a position that would seem nonsensical in the political climates of later administrations—policymakers found the environment useful,

² Hamblin certainly was not the first to study this concept, as changing views of nature have their own historiography. His article on the United Nations Conference on the Human Environment that eventually produced the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (also called the London Dumping Convention) argued, “Regardless of whether those who protected dumping were gods or devils, they wielded their power and influence in the details—in the definitions, in the exemptions, in the complicated black and gray lists—rather than in the public acclaimed convention ‘banning’ the disposal of waste at sea.” Jacob Darwin Hamblin, “Gods and Devils in the Details: Marine Pollution, Radioactive Waste, and an Environmental Regime circa 1972,” *Diplomatic History*, Vol. 32, No. 4 (September 2008), 540, 542.

³ In fact, a section in the July 1950 AEC Report to Congress described “Dilution as a Safeguard” when discussing airborne nuclear waste. *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 80.

⁴ Hamblin contended that his book was “a history of the scientific, political, and diplomatic controversies connected to disposing radioactive waste at sea, told in the context of the democratic nuclear powers.” He further wrote, “The history of ocean disposal of radioactive waste is less about the triumph of environmentalism and more about science, politics, and diplomacy. [...] The narrative is guided by four broad and interrelated themes, explained in detail below, each highlighting the fact that sea disposal policies hinged upon struggles for scientific authority—between governments, between institutions, and between groups of scientists vying for influence, patronage, or decision-making power.” Fundamentally, Hamblin questioned whether the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter helped out the environment at all when he wrote this dualistic statement: “An environmentalist might rejoice at the London Convention, but a cynic might justifiably call it a legalistic chimera. It led nations to scrutinize even construction silt dumped far out at sea, but to stare unblinkingly at the continuous flow of waste emanating from nuclear reprocessing pipelines right offshore.” Jacob Darwin Hamblin, *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (New Brunswick: Rutgers University Press, 2008), 2, 4, 254.

important, and worth understanding, but did so in the context of seeking how to best fill various land and seascapes with as much waste as possible without affecting the bodies of U.S. citizens.

This chapter delves into how the United States and its decision makers used the available environmental science to deal with one of the end results of many atomic processes—nuclear waste. Nearly every facet of the nuclear complex produced some sort of radioactive waste, from low-level wastes (like contaminated gloves or lightly radioactive coolant water) to very high-level radioactive wastes that contained a great amount of dangerous radioactivity, such as the very harmful Strontium 90. Decisions made by those in the U.S. government can help show how many policymakers thought about not only radiation from nuclear waste, but also the environment into which those waste products went. When making choices about disposing radioactive waste, decision makers had to balance human and environmental health with the very real need to deal with the radioactive byproducts produced by parts of the nuclear complex deemed necessary and vital to national security and the welfare of the country's citizenry. In doing so, policymakers, especially at the Atomic Energy Commission (AEC), treated radioactive waste just like they would any other trash, except with the added dimension of radiation. This meant any decision made started from a default position of dumping the waste where other rubbish might go and from there attempted to solve the problem of radiation.

Previous chapters ruminated on single aspects of the development of the nuclear complex and crafted an historical narrative about the thoughts and considerations of those in power on that subject. This chapter, however, is slightly different. While it also goes

mostly in chronological order, the chapter seeks less to tell a story than it does to explain a way of thinking that stayed more or less constant during the studied period. In essence, policymakers did not shift their way of thinking from older paradigms and instead attempted to shoehorn nuclear waste policies into already existing modes of thought. The chapter also highlights a fundamental fact about waste disposal that still exists in present ways of thinking. When humans put something in the garbage or otherwise dispose of it, that trash does not disappear—it just goes elsewhere. Nuclear waste is the same way, except it also has the added problem of radiation that might very easily leak into the surrounding environs, which reminds humans that they have not truly disposed of trash, merely displaced it. Policymakers never quite went beyond this “out of sight, out of mind” attitude, even though they had the necessary tools available to change the models they used to reach determinations about waste disposal—constantly improving understandings about the interaction between radioactive waste and the natural world.

During the early Truman presidency, policymakers paid very little attention to what might happen to nuclear products after their use. Perhaps the most powerful demonstration of that notion is the archival holdings in the Harry S. Truman Presidential Library, where the offhand quip in J. B. Conant’s speech was the only mention of nuclear waste disposal found by this author. The July 1949 Semiannual Report of the AEC to Congress contained little more than a page on the subject, with that page focused heavily on how radioactive waste might affect human bodies. The report claimed, “In setting the [safety level for humans], the problem was less that human drinking water might become contaminated than that people might eat animals that drank water in discharge streams or

fish that fed on micro-organisms that had absorbed radioactive material.”⁵ That statement gave a clear implication about how decision makers understood radiation in environments that was very similar to what Chapter Two showed about early understandings of radioactive fallout—the only real problem with radiation in the natural world was that it might eventually end up in human bodies. Polluted streams, fish, microorganisms, meat animals, and oceans only became a problem if humans might possibly ingest some of the radiation that had entered those biological and ecological systems. The AEC report six months later in January 1950 contained a mere paragraph on “Handling Radioactive Wastes” that mentioned a study at Mound Laboratory at Miamisburg, Ohio.⁶

The AEC did understand that its actions could have environmental consequences, however, and its July 1950 report to Congress, in a section on “Environmental Safeguards,” showed an evolving focus on dealing with radioactive waste and the recognition that the government needed more solutions. The AEC claimed that it considered safeguarding the areas surrounding atomic energy installations just as important as protecting AEC workers and said that it set the “Permissible levels of radiation released from routine operations into the environment [extremely low]—at or below the levels of background radiation under many natural conditions.”⁷ Again, however, the fear of environmental contamination remained firmly focused on possible threats to human bodies. And no matter the precautions, AEC actions frequently produced radiation and contaminated various products with that radiation, necessitating that the Commission do something to ensure the safety of humans and the environment.

In 1950, the AEC considered only two methods of controlling radioactive wastes

⁵ *Sixth Semiannual Report of the Atomic Energy Commission, July 1949*, 62.

⁶ *Seventh Semiannual Report of the Atomic Energy Commission, January 1950*, 124.

⁷ *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 98.

to be viable options (not producing the wastes in the first place was not one of the options). The first possibility involved concentrating radioactive products so that these could be stored in select places where humans might be least affected (for example, cast into concrete and then sunk deep into the ocean). The alternative involved “mixing the material with so much nonradioactive material (air, water, or a stable isotope of the same material) that it will be harmlessly dispersed.”⁸ In this scenario, radioactive effluence got treated just like many other pollutants—radioactivity could be put directly into the air or water so long as a sufficient enough supply of the diluting agent existed. This mindset portrayed radioactivity as being no different than other hazards and implied that as long as the AEC diluted radioactive wastes enough these presented no discernable harm to humans, just like a kettle of boiling water is safe so long as it is mixed with enough cold water from the tap.

On top of these general strategies, the AEC also carefully measured the environs surrounding its production facilities to ensure that disposal plans safely worked. Sites like Oak Ridge in Tennessee and Argonne Laboratories in Chicago needed careful monitoring so that the AEC could be sure it mediated any dangers. Of course, once dumped the radioactive waste had to be guarded to keep out anyone who might go near it and the local environments near the dumping site also had to be monitored. One of the best ways to prevent dangers, then, involved carefully choosing AEC sites to minimize the chances of any incident. When choosing a reactor location, “The AEC determined that such reactors should be tested on a large reservation of public land—preferably of submarginal value for farming and ranching and not suitable for future agricultural, mining, or other development—whose very extent would serve to guard the population of the surrounding

⁸ *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 98-99.

area against potential hazard. The geology of the site was of importance; the earthquake risk had to be small.”⁹

Yet AEC policies supported almost contradictory conclusions, as the Commission cared deeply about environmental contamination, but did not necessarily care if that contamination harmed the environment. That is to say, the AEC showed little early concern that its radioactive waste might harm the plants or animals in dumping environments—the biota normally considered when describing the natural world. The Commission did care, however, that if it polluted the natural world with radiation that such radioactivity might eventually make its way through natural systems into human bodies. Thus environmental contamination with radioactivity mattered a great deal to the AEC, but only for the sake of human health, not for the environment’s sake. For example, the AEC studied each site carefully to account for unique characteristics of each landscape—radioactive products surely would behave differently in a desert setting with underground water than at the Hanford plant on the Columbia River in Washington State. And yet, for all that careful monitoring, the most important measurements concerned how humans might be affected. For example, the subsection on “*River Studies*” held that for humans to be affected by excess radiation in fish, a person would have to eat a hundred pounds of these fish in one sitting, or ten pounds a day for a very long time “to get any appreciable dose of radioactivity.” The fact that the fish themselves were corrupted by radiation that might affect their own biological processes was inconsequential as in the

⁹ The AEC seemed confident that testing showed no appreciable environmental harm from radioactivity. On Oak Ridge, the Commission claimed, “The U.S. Weather Bureau conducts thorough meteorological surveys under a cooperative agreement with the AEC. The work involves detailed measurement of wind flow and temperature in the broken ridge country surrounding the plants, including the behavior of the upper atmosphere.” About Argonne, the Commission asserted, “Here, as at other atomic energy centers, tests are conducted to make sure that plant, fish, and animal life downstream from the Laboratory are not reconcentrating extremely dilute radioactive wastes to any dangerous extent.” *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 99-105.

final equation all that mattered was how humans might suffer from consumption of piscine bodies.¹⁰

Other plans, such as “releasing radioisotope wastes into public sewers,” showed that policymakers conceived of radioactive waste disposal very similarly to how they would traditional waste disposal at the time. In an AEC-supported project at New York’s Mount Sinai Hospital, a study looked into the hospital potentially disposing radioactive iodine and phosphorous—used in medical research—directly into the public sewer system. The study found “no danger to sewage disposal workers” because the sewer system diluted the radioactive products to a sufficient degree. The AEC further declared, “Plumbing fixtures through which isotope wastes had passed were dismantled, tested, and found below any degree of radioactive contamination that might be hazardous to plumbers working on the fixtures.”¹¹

Such a practice seemed fine on a conceptual level and research findings also found no detectable danger, but still causes pause because of the intellectual underpinnings involved. That the AEC even undertook such a study reflects a way of thinking that radiation was no different than any other pollutant. The Commission may have determined that the radioactivity remained at safe levels, but as Chapter Two showed, no one truly knew what safe levels were. Beyond immediate dangers, no data existed on what might happen if humans received low-level exposure over the course of a decade or two (indeed, how could such data exist considering the atomic age was less than a decade old?). The AEC brought into this situation, and others, a style of thinking

¹⁰ The AEC was relatively secure in its assertions that it had everything under control, such as when the report stated, “From evidence now at hand there is no reason to believe that the operation of the Hanford piles will have any harmful effect on the natural balance of plant and animal life in the [Columbia] river.” *Eighth Semiannual Report of the Atomic Energy Commission, July 1950*, 105-118.

¹¹ *Tenth Semiannual Report of the Atomic Energy Commission, July 1951*, 42.

in keeping with contemporary scientists and government officials and proved unable to move beyond such thought patterns and appraise atomic energy as something new and distinct that required eschewing previous assumptions. Whether pouring radioisotope tracers into the sewers was ultimately safe or not, the AEC did not have a sufficient basis to make a judgment either way and yet still attempted the experiment.

Continuing AEC research showed that the Commission did not necessarily think that it had the problem under control, even if the organization did think its plans moved in the right direction. The July 1952 report to Congress sounded very positive and proactive, claiming, “Research, development, and investigations in sanitary engineering were advanced by AEC contractors during the first half of 1952 to obtain more efficient handling and disposal of wastes at lower cost and to secure better information on the environmental aspects of atomic energy operations.” In short, AEC research programs frequently studied whether traditional methods of waste disposal could be used to deal with radioactive wastes, particularly high-volume, low-level waste. For example, at Johns Hopkins University, experiments tested whether conventional incineration could safely dispose of wastes containing radioactive phosphorous. That study found ninety percent of the radioactivity went into the ash with the remainder depositing in the stack and in small particles in the smoke.¹² Another evaluation declared that burning low level wastes in isolated areas seemed like a good idea and was the cheapest way to dispose of products

¹² *Twelfth Semiannual Report of the Atomic Energy Commission, July 1952*, 19-20. Various nuclear refinement processes also could produce radioactive “ash,” which also could cause concern. DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Campaign Series, Box 6, Folder Atomic Energy, Memo to Bernard M. Baruch from John M. Hancock, 29 September 1952, 4.

“without health hazard.”¹³ Burning might have worked for other industrial wastes, but all it likely did for radioactive wastes was spew radioactive ash into the air.

Plans still called for low-level radioactive waste to be put directly into bodies of water, but research attempted to improve how that took place and better understand what happened after the dumping. At the University of Texas, researchers tried concentrating liquid radioactive wastes into algae, which would then be removed from the water by rotary vacuum filters. This would not diminish the amount of radioactivity involved, but would reduce the amount of radioactive liquid to manage.¹⁴ Other work put radioactive tracers into water to determine how long the radiation lasted in rivers. For example, in New York’s Mohawk River, “Preliminary analyses indicated that, under the test conditions, in roughly 5,000 feet of stream travel, the radioactivity concentration at the outfall was diluted to essentially background or harmless levels.” Yet again, disposal plans drew upon the idea that “dilution is the solution to pollution.” Of course, none of this meant that the AEC necessarily had the issue under control. The January 1955 report to Congress declared, “The disposal of radioactive waste is a major problem in the atomic energy program.”¹⁵

High-level radioactive wastes constituted an even more significant problem. Chemical plants that processed irradiated fuel elements constituted the main source of such products. The AEC considered many different types of disposal, including ocean dumping, underground holding, pumping into wells, and incineration.¹⁶ Yet no matter how much scientific knowledge AEC research produced no perfect solutions existed. In

¹³ *Seventeenth Semiannual Report of the Atomic Energy Commission, January 1955*, 53.

¹⁴ *Fifteenth Semiannual Report of the Atomic Energy Commission, January 1954*, 26.

¹⁵ Other “methods for the disposal of contaminated scrap include storage, burial, sea disposal and incineration.” *Seventeenth Semiannual Report of the Atomic Energy Commission, January 1955*, 30-31, 53.

¹⁶ *Nineteenth Semiannual Report of the Atomic Energy Commission, January 1956*, 51-52.

general, the AEC took three primary approaches to disposing highly radioactive products—fixate the fission products in other mediums for easier storage; selectively remove the worst parts so that the bulk could be more easily handled; or discharge the highly radioactive wastes as they were into holding tanks or specially selected geologic formations.¹⁷ None of these options could do anything to actually diminish the amount of radioactivity contained in the effluence, even if the methods hopefully could avoid any potential damage to human health or landscapes outside of the dumping grounds.

In the latter few years of the 1950s, focus on dealing with radioactive wastes increased so much that the AEC declared, “The problem of handling and disposing of radioactive wastes runs through the entire fabric of nuclear energy operations.” Reminding readers that matter in any state—gas, liquid, or solid—could emit radioactivity, the January 1957 report to Congress summed up the issue clearly when it claimed, “Because of the long life of some radioactivity, the ability of radiation to cause injury to human, plant and animal life, and its potential danger as an environmental contaminant, the safe handling and final disposal of wastes is important to the successful application of nuclear energy to peaceful uses.” Thus the AEC had several objectives in dealing with the radioactive products: to develop better and cheaper ways to handle and dispose of the waste; determine how much natural systems would dilute wastes and lessen the required treatment; learn more about “fundamental phenomena”; aid integration of nationwide agencies; and assist concerned state and local officials.¹⁸ In short, though the whole program could be improved, from the nitty-gritty technical

¹⁷ *Twentieth Semiannual Report of the Atomic Energy Commission, July 1956*, 60-62.

¹⁸ *Twenty-First Semiannual Report of the Atomic Energy Commission, January 1957*, 151-152.

aspects to the larger, structural features, but the AEC had recognized the challenges involved by 1957.

One thing the AEC made clear, however, is that once radioactive wastes had been disposed of out of sight, it still took a long time for these to be safely out of mind. For example, workers could bury radioactive wastes, but facilities still needed to erect fences to limit access and monitor nearby waters and soils. At the Hanford processing facility, as another example, after cooling water had been put in a storage basin to reduce some of the radioactivity and finally returned to the Columbia River to be diluted, that river needed continual study to ensure no ill effects occurred. At the Oak Ridge facility, workers excavated three pits “in the relatively impervious Conasauga shale” and between 1951-1957 dumped more than four million gallons of low-level waste into “open seepage pits,” necessitating downstream monitoring to ensure drinking water safety. Since the production of every gallon of processed uranium also created between one-tenth and one gallon of high-level liquid waste, merely storing such liquids in tanks was not “a final economical answer. On the other hand, sufficient dilution probably is not available in nature for any safe, continuing dispersal to the environment.” Thus researchers attempted to find other solutions, such as heating the liquids to very high temperatures until these became a dry oxide powder (which could be packaged as a solid or mixed with clay and fused in a kiln to form a ceramic mass). Other possible solutions included discharging the liquid into subterranean salt beds or salt domes between 5,000 and 15,000 feet in depth or pumping the liquid deep into the sea where planners and scientists thought that little sea life and slow circulation would prevent damage to humans.¹⁹ Either way, waste disposal remained an unresolved issue in 1957. Moreover, policymakers realized that their choices

¹⁹ *Twenty-First Semiannual Report of the Atomic Energy Commission, January 1957*, 156-158.

could have serious ramifications and thus required frequent reevaluations to be sure that no problems arose.

Even though it seems now that nuclear waste constituted a serious problem in the nuclear complex, not all wastes were created equally, as whether nuclear waste was liquid or solid, high or low level could make a significant difference. In 1957 the Commission declared, “The handling and disposal of solid wastes have at no time constituted a serious technical problem.” To justify such a claim, the AEC reported about test dumping thirty miles off of San Francisco’s coast. The Scripps Institute for Oceanography studied that site and “tended to confirm that waste disposal there has produced no harmful effects.” Liquid wastes, however, especially of high-level radiation, “remained the major technological problem in disposal.” The best the AEC could do with that fluid was to store it in tanks, and to that date the Commission had placed 65 million gallons containing millions of curies of radioactivity in tank storage.²⁰ Thus while the AEC may have “solved” some of its radioactive waste problems, others remained significant hurdles.

The January 1958 AEC report to Congress contained a section on “Sanitary engineering research” that said research primarily focused on waste handling and disposal, the water supply, and environmental sanitation. For low level wastes, researchers tested biologic sewage treatments, and results indicated that 70-90% of “low-level mixed fission products can be removed.” And even easier than disposing of low-level radioactive wastes itself, the AEC had licensed seven commercial firms to do the disposal for the U.S. government. Such disposal was “generally limited to handling small quantities of radioactive waste material. The wastes are disposed of at sea, are stored, or

²⁰ *Twenty-second Semiannual Report of the Atomic Energy Commission, July 1957, 69-70.*

in some instances are returned to the Commission for permanent burial. The hazards, both operational and long term, are comparatively slight.” Such solutions would not work on “High-level residues,” of course, and the previous tripartite research into fixation into an inert solid, selective removal of specific isotopes, and direct discharge to selected geological formations continued. Most of that research, however, was not entirely viable so most high-level liquid waste went directly into underground storage tanks.²¹ Even with plans for either drying radioactive liquid waste to “a less hazardous, noncorrosive solid product” or possibly drilling into a salt formation at the Naval Air Station at Hutchinson, Kansas, high-level radioactivity products remained a serious problem.²²

The Commission did continue to develop different ways to deal with low-level disposal, including furthering relationships with other organizations. In 1958, the AEC formed a special subcommittee to work under the auspices of the National Academy of Sciences’ Committee on Oceanography. That subcommittee examined “the feasibility of establishing a limited number of *new sea disposal sites* in the Atlantic Ocean and Gulf of Mexico for use in commercial disposal of low-level radioactive wastes. If feasible, new sites will be recommended closer to the coast-line than the presently recommended 100 miles or more offshore.”²³ In addition to farming out research, the Commission also continued to distribute licenses for waste disposal, and as of 31 December 1958, “8 licenses were in effect, 6 for waste disposal in the Atlantic or Pacific Oceans, 1 for storage, and 1 for packaging and returning wastes to the Commission.” The AEC decided not to spell out “precise details for waste disposal” in guidelines to these companies

²¹ *Twenty-third Semiannual Report of the Atomic Energy Commission, January 1958*, 133-151.

²² *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 101-102.

²³ Italics are in original. *Twenty-fourth Semiannual Report of the Atomic Energy Commission, July 1958*, 103.

because there are so many “varied and complex technical problems” that giving leeway seemed more appropriate. The application process for ocean disposal did require a great deal of information, however, which gave the AEC the at least the illusion of control even if it took a fairly *laissez-faire* approach after it had distributed a license.²⁴

In July 1959, the AEC’s assurances were not enough to placate the nation’s citizenry, and a newspaper article on radioactive waste contamination in rivers caused the Commission concern. That article reported that the Department of Health, Education, and Welfare (HEW) sought to end radioactive contamination of U.S. rivers and streams by uranium refineries. It claimed that about “half of the 28 ore-processing plants now in operation are dumping radium and other waste products into rivers in the West,” with some levels as much as twenty-two times the maximum permissible radiation levels. Arthur S. Flemming, the HEW secretary, had scathing criticisms for the AEC and vowed that rivers needed to be both cleaned up and studied.²⁵

AEC Chairman John McCone referenced that article in a Commissioners’ meeting on the day the article ran and said he was “seriously concerned about the growing volume of criticism AEC was receiving on the problem of radiation contamination.” Reports at that meeting claimed that the AEC had essentially been doing its due diligence by inspecting uranium milling operations and sending out notifications of noncompliance when necessary. Moreover, the Commissioners noted two different factors at play in the

²⁴ The January 1959 AEC report to Congress stated, “An application for a license to dispose of radioactive waste in the ocean must include a detailed description of the quantities and kinds of material and the proposed manner and conditions of disposal. The applicant must give detailed information on container and packing specifications, processing facilities, transportation, instrumentation for measuring radiation levels and contamination, radiation safety procedures to be followed in collecting, storing, packaging, and transporting the material; site of disposal, including depth of water at the proposed site, and the records of disposal that will be maintained.” *Twenty-fifth Semiannual Report of the Atomic Energy Commission, January 1959*, 13-14.

²⁵ Edward Gamarekian, “HEW Acts to End A-Contamination of Rivers,” *The Washington Post and Times Herald*, 15 July 1959, A7.

situation. First, they claimed that river contamination does not tell the whole story, as duration of exposure mattered, and if the rivers were cleaned up soon “no harmful effects will result.” The second point, in a bit of political maneuvering, was that while AEC responsibility covered regulating the radioactive level of effluent and dust the mills produced, “condition of the rivers as a whole is the responsibility of the Public Health Service.” Again, the AEC viewed its dumping mostly through the lens of human health and not environmental health—only when human bodies were threatened did environmental contamination become a significant problem. Other fears concerned “public misunderstandings concerning AEC policies on ocean disposal of radioactive waste.” In the end, the Commissioners decided that they needed an integrated organization within the AEC to efficiently administer the entire waste disposal program and to be capable of effectively allaying the mounting public fears about this situation.”²⁶ An event a few days later would show that the AEC did indeed have reason to fear public concern.

In mid-July 1959, the Providence *Evening Bulletin* reported on “tentative plans for disposal of quote low intensity atomic waste unquote close to Rhode Island Coast.”²⁷ Christopher Del Sesto, Rhode Island’s governor, wrote to President Eisenhower and expressed concern. He thought, “Any action of this kind would seriously affect Rhode Island’s attraction as a vacation area and might also endanger the marine life for which the state is renowned.” Del Sesto continued, “I feel that too little is presently known about nuclear waste to accept a proposal such as the committee on Oceanography has

²⁶ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1528, 15 July 1959, 446-447.

²⁷ DDEL, White House Central Files, General File, Box 1214, Folder 155, 1959-60, Telegram from Robert G. MacLaughlin of Westkingston, RI to the President, 17 July 1959

offered, and I therefore respectfully request that you intercede in behalf of Rhode Island” and stop the program.²⁸

The AEC response to Governor Del Sesto claimed that the Commission had “direct responsibility for control of this activity” with no present plans for using or approving the sites without more research by a variety of groups. It ended, “Please be assured that in our consideration of these matters, protection of the public health and safety, and conservation of our natural resources will always be of paramount importance.”²⁹ Another concerned citizen called the plans a “patent disregard for the welfare of humanity.” He argued, “If the government of this country can expend billions of dollars on the development of atomic weapons and processes it can and must include in that budget funds for safeguard against a fate more horrible than most men can imagine, which can and probably will result from those weapons and processes.” That man concluded his message to the President by saying, “Contamination of Earth is a one way street.”³⁰ These letters emphasize not only public worry about dumping plans, but also how such activities might affect the natural world—and through it affect human health. Particularly, they highlight citizens concerned about the state of scientific knowledge and whether the AEC knew enough to follow through with its plans.

The AEC, however, continued its plans for ocean dumping, which shows that public concern could only go so far and that the seas still represented one of the best places to dump. On 25 July 1959, a special legislative note from the AEC to the White

²⁸ DDEL, White House Central Files, Official File, Box 450, Folder 4, Letter Christopher Del Sesto to President, 20 July 1959

²⁹ DDEL, White House Central Files, Official File, Box 450, Folder 4, Letter William B. Persons to Christopher Del Sesto, 3 August 1959

³⁰ DDEL, White House Central Files, General File, Box 1214, Folder 155, 1959-60, Telegram from Robert G. MacLaughlin of Westkingston, RI to the President, 17 July 1959

House highlighted a hearing the following week by the Congressional Joint Committee on Atomic Energy (JCAE) on a National Academy of Sciences (NAS) report titled “Radioactive Waste Disposal Into Atlantic and Gulf Coast Waters.” The Commission claimed that, particularly, “The JCAE is concerned over Congressional and public apprehension generated by this report and also anxious to preserve its jurisdiction in the field of atomic waste disposal.”³¹ That report was from the NAS’ Committee on Oceanography, whose general objectives were “to assist in the development of the marine sciences, to encourage basic research and to advise the government agencies on various oceanographic problems.” Thus “the problems of disposal of low level radioactive wastes” into ocean waters fit well within that committee’s base of expertise and made it a logical choice for the AEC, Office of Naval Research, and Bureau of Commercial Fisheries to request investigation.³²

The report attempted “to provide an estimate of the rate of return of radioactive substances to man, arising from stated rates of disposal into the coastal areas,” which again emphasizes a focus on human health. The NAS committee said that the current practice of mixing low-level wastes with concrete and storing it in a 55-gallon drum would only provide containment for about ten years, but that this should be long enough for the products to lose all radioactivity. No matter how safe the practice, the report declared that some sites would not be suitable (such as coastal estuaries, bays, and regions immediately seaward of these areas) and recommended more studies of coastal circulation and especially circulation of bottom waters. All in all, it claimed the dumping

³¹ DDEL, Dwight D. Eisenhower Papers as President, Ann Whitman File, Diary Series, Box 42, Folder Toner Notes July 1959, Special Legislative Note, 25 July 1959

³² National Academy of Sciences—National Research Council, Publication 655, 1959, “Radioactive Waste Disposal into Atlantic and Gulf Coast Waters,” i-vii.

practice should be safe, unless shellfisheries were nearby as radioactivity very possibly could sink into bottom sediments, get taken in by shellfish, and then consumed by humans. The report perceived this potential radioactive shellfish problem as the most serious danger of the radioactive dumping, again not because of the damage the shellfish might incur, but because humans might eat some of them. No matter the risks involved, as its final recommendation the report suggested, “The panel is of the opinion that certain Atlantic and Gulf of Mexico coastal areas can be used as receiving waters for the controlled disposal of packaged, low level, radioactive wastes.”³³

More interestingly, the ways the report went into a great level of detail reflected a different position than decision makers had taken previously—nuclear waste became a bigger problem with each passing year due to increasing peacetime nuclear production, and the resulting wastes could not be disposed by conventional methods (municipal incinerators, sanitary landfills, etc.). In all, the AEC dumped less than 6,000 curies of products between 1951-1958 in Atlantic waters, mostly in the form of “solid materials such as paper wipes, rags, mops, ashes, animal carcasses and contaminated laboratory paraphernalia.” Of course, playing back to the point that disposing of nuclear waste was fundamentally different than conventional wastes, the report pointed out that the type of isotope being dumped (ex. strontium vs. something less harmful like tritium) played a huge role in the environmental effects. Moreover, putting these products in the ocean differed a great deal from storing other wastes in landfills. For example, at a depth of a

³³ It clarified this larger recommendation by saying before any final site was selected, five conditions had to be met: (1) a survey of the area must be conducted “to determine details of local circulation and an inventory of the biota, especially of bottom-living organisms”; (2) only so much could be dumped (radioactivity wise); (3) sites needed to be at least 75 miles apart and no 300 mile stretch of coastline should have more than 3 sites; (4) containers should be designed so that if a container breaks no part of it should float to the top; (5) area should be monitored periodically. National Academy of Sciences—National Research Council, Publication 655, 1959, “Radioactive Waste Disposal into Atlantic and Gulf Coast Waters,” 1-3.

thousand fathoms (a little over a mile), disposal canisters encountered over 3,000 pounds per square inch of pressure, and any rupture of those vessels would release radioactive products into the natural circulation of ocean waters. This would dilute the radioactive waste, but also allow it to enter ecosystems. Apart from such known factors, a great many unknown issues—absorption factors and previously mentioned ocean circulation patterns—also played important roles. Thus no matter the environmental and scientific knowledge accumulated, the report summarized, “A precise evaluation of the quantity of radioactive substances that will be returned to man as the result of a stated rate of disposal into any one of the selected areas cannot be given.”³⁴ Nevertheless, this did not stop the NAS committee from making pro-dumping recommendations and policymakers from making decisions that implicitly assumed that they knew enough to go forward with dumping plans.

Moreover, after dealing with nuclear waste for over a decade, U.S. lawmakers worked to decrease federal responsibility for certain nuclear wastes. On 23 September 1959 President Eisenhower signed Public Law (P.L.) 86-373 as an amendment to the Atomic Energy Act. The intention behind P.L. 86-373 was to allow the AEC to shift authority for disposing of nuclear waste over to state control, so long as the nuclear materials were “of less than a critical mass” (that is to say, could not be used to make a nuclear bomb). If a state’s governor agreed and the AEC thought the state had an adequate program to deal with such wastes, the AEC would delegate some of its

³⁴ In one place, the report claimed: “Although impossible to evaluate quantitatively, it seems certain that sorption processes will play a major role in controlling the dispersal of radioactive wastes once they are free of the canister.” In the end, the committee did not even include sorption factors into their calculations because they could not calculate it, but believed that this meant recommendations should “include a safety factor of at least 10, and possibly more.” Clearly, in some instances they were just guessing. . National Academy of Sciences—National Research Council, Publication 655, 1959, “Radioactive Waste Disposal into Atlantic and Gulf Coast Waters,” 4-35.

responsibility. Moreover, the AEC wanted the states to get behind P.L. 86-373 as quickly as possible, and as quickly as a state regulatory programs could be “designed to protect the health and safety of the people against radiation hazards and to encourage the constructive uses of radiation.” In doing so, the Commission approved that when disposing such radioactive materials, “certain limited quantities may be safely discharged into the air, water, and sewers, and buried in the soil.”³⁵ This law was all a part of normalizing nuclear waste products and likely as much about reducing public fears as helping the AEC reduce its workload. With this move, the Commission showed that if it was willing for the states to handle such products, surely these wastes could not be terribly dangerous or worth much anxiety.

No matter how hard the AEC worked to dispel worries about disposal, its policies still could engender great fear, such as the minor international incident generated in late 1959 when the United States proposed granting a license to dump radioactive waste in the Gulf of Mexico. The license would let the waste be placed in the ocean equidistant from both U.S. and Mexican territories, and the Mexican Embassy at Washington “expressed its opposition to the proposed license for unspecified scientific and technical reasons and for reasons of a political and public relations nature.” Moreover, the Mexican government

³⁵ The AEC thought that states could acceptably dispose of wastes in a variety of ways: burial, limited disposal into sewers, river dumping in low concentrations, incineration, ocean disposal, or even transfer to another licensed disposal agency. Or, states could reuse the products, and “A Limited number of licenses have been issued for studies involving the controlled release of radioisotopes into the environs. Examples of such field uses include fluid flow studies in oil wells and in streams. The quantities and dilutions involved in most field studies usually provide for radiation concentrations which are sufficient for technical measurements but which are a very small fraction of permissible levels.” DDEL, White House Central Files, Official File, Box 454, Folder OF 108-F Atoms For Peace (12), Proposed Criteria for Guidance of States and the AEC in the Discontinuance of AEC Regulatory Authority Over Byproduct, Source and Special Nuclear Materials in Less Than a Critical Mass and the Assumption Thereof by States Through Agreement. The act itself said its first purpose was, “to recognize the interests of the States in the peaceful uses of atomic energy, and to clarify the respective responsibilities under this Act of the States and the Commission with respect to the regulation of byproduct, source, and special nuclear materials.” DDEL, White House Central Files, Official File, Box 454, Folder OF 108-F Atoms For Peace (12), Public Law 86-373, 86th Congress, S. 2568, 23 September 1959.

believed dumping so close to Mexican shores represented “a unilateral and arbitrary act on the part of the United States, any adverse results from which would present virtually identical hazards to the residents of the two countries.” Mexican officials also declared that, although the U.S. government had allowed them to attend the licensing hearings, they believed if the situation had been reversed the United States would not feel it had received an appropriate say in the matter. Concerns also existed over why the selected site was 180 miles from both shores, “particularly as so little can be known with certainty in Mexico regarding the possible adverse effects oceanic waste disposal might have over a long period of time.”³⁶ A later AEC memo decreed that the United States should deny the dumping license because of the potential adverse affect on foreign relations with Mexico.³⁷ Early in 1960, a White House memo declared, “As a result of protests from Mexico, backed by the Department of State, the Atomic Energy Commission is considering denying a license for disposal of radioactive industrial wastes in the Gulf of Mexico.”³⁸ Clearly, even though the AEC tried to mitigate any worries about disposal plans, AEC dumping still engendered palpable fear among many, both in and out of the United States.

Moreover, the AEC knew that the public frequently disapproved of dumping decisions and intentionally tried to mask these as much as possible. A mid-December

³⁶ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 5, Folder Nuclear Energy Matters (8) [Sept 1959-Mar 1960], Letter R. R. Rubottom, Jr. to John A. McCone, 18 November 1959. Rubottom was Assistant Secretary of State.

³⁷ DDEL, White House Office, Office of the Special Assistant, OCB Series, Subject Subseries, Box 5, Folder Nuclear Energy Matters (8) [Sept 1959-Mar 1960], Memorandum for the Executive Officer, Subj: Industrial Radioactive Waste Disposal in the Gulf of Mexico 22 December 1959. By Richard Hirsch.

³⁸ However, the memo continued, “Since the method of disposal is considered safe, the licensee may seek a judicial review. The [Operations Coordinating Board] has been alerted to the situation, and will attempt to deal with problems as they arise.” DDEL, White House Office, Office of the Special Assistant, OCB Series, Administrative Subseries, Box 2, Folder Chronological - Karl G. Harr January 1960 - January 1961 (1), Memo from J. I. Coffey to Toner, 5 January 1960

1959 meeting of the AEC Commissioners discussed the establishment of land disposal sites for radioactive wastes. At that meeting, the Commissioners approved creating permanent land disposal sites on government-owned land (either federal or state), and authorized Oak Ridge in Tennessee and a site in Idaho as interim disposal sites pending study and evaluation of other sites. However, in studying and approving those other sites, the Commissioners declared at their meeting, “in accordance with past AEC practices when site selections were being made, site selection activities will be conducted with as little publicity as possible but that appropriate and useful public relations activities will be undertaken at the time of selection of sites to help assure public acceptance.”³⁹ In very open language, then, the AEC’s top policymakers agreed that plans for creating nuclear waste grounds should be withheld from the public whenever possible, with only very certain types of public relations spin even attempted. Whether decision makers truly thought that no problems existed with their dumping plans or not, they certainly knew that the general U.S. public certainly would have significant concerns.

The AEC did attempt to dispel concerns when it could, however, such as when Commissioners met with representatives from the State of New Jersey on 11 February 1960. Particularly, the Garden State’s representatives cited the previously mentioned National Academy of Sciences study on “Radioactive Waste Disposal Into Atlantic and Gulf Coast Waters,” which had indicated the possibility of inshore dumping. Such concerns existed even though the New Jersey Department of Health representative claimed that he knew of no health problems with any of the present disposal sites. The AEC responded, contrary to the NAS report’s claims, that while the Commission had

³⁹ NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1573, 15 December 1959, 670.

plans for disposing wastes 150-230 miles off of Sandy Hook, New Jersey, it had no plans for inshore sites off of the New Jersey coast. Moreover, both the AEC and New Jersey representatives realized that if the state officials had such problems with potential inshore disposal sites, then they “would have a major public relations problem in convincing the public that chemical processing plants handling significant quantities of radioactive materials could be operated safely within the state.”⁴⁰ Worries about ocean disposal did begin to cause changes in decision-making.

In some ways, the AEC of 1960 began to consider whether ocean dumping should be used less in favor of land disposal. One study showed that in most cases, land disposal “would be both feasible and less expensive than sea disposal.” Reports claimed that if the AEC had pursued such a plan at the time, the temporary sites at Oak Ridge and in Idaho would be capable of handling all low-level radioactive waste produced by the United States until 1965. That study only focused on low-level wastes, however, since transportation costs for such was low because those nuclear products required no special shielding. AEC Chairman John McCone did ask whether there was a “danger of buried waste material leaching radioactivity into the earth and eventually reaching rivers and streams,” which demonstrated an understanding of how the natural world and its systems work. On top of the cheaper cost, however, “the risk of accidental release from the burial ground would not be significantly increased by burying a large amount of waste since there is adequate control of the burial ground.”⁴¹

⁴⁰ NACP, 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Summary Notes of Meeting with Representatives of the State of New Jersey, 11 Feb 1960

⁴¹ The study did conclude that, “However, highly radioactive wastes from plants located near the coast and requiring concrete shielding probably could be disposed of more cheaply at sea.” NACP, RG 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 13, Meeting No. 1617, 6 May 1960, 325-327.

Later on, the Commissioners discussed a letter to the Earth Sciences Division of the National Academy of Sciences-National Research Council. The letter was designed to reply to concerns held by the Earth Sciences Division about waste disposal, but internal discussion emphasized that the Commissioners believed the NAS committee only held competence on geological aspects and any discussion about waste disposal more generally was outside its field of knowledge. Moreover, the Commissioners decided that their letter to the Earth Sciences Division should say, “However, we assume you do not mean that zero radioactivity should be allowed to reach man’s environment. This would raise fundamental questions including those of a biological and medical nature that are very broad.”⁴² This response to members of the scientific community showed that scientific advice did not always receive the warm welcome it had when the NAS issued its longer report just a year earlier. It also illuminated an assumption that there was nothing inherently wrong with releasing radiation into the natural world, so long as it was done in a controlled manner. The AEC thus recognized that its actions demonstrated that there frequently is very little difference between waste disposal and controlled pollution.

The AEC report to Congress for 1959 provides a good endpoint for understanding AEC opinions on dumping during the Truman and Eisenhower presidencies. That report contained over seventy pages (nearly a fifth of the document) on nuclear waste disposal and contained the most expansive treatise on the Commission’s positions and activities on the subject to date. The section claimed, “The major objective of waste management in atomic energy operations is control over the radiation hazard that might be produced by these wastes, either in storage or in nature.” To this end, two basic disposal concepts

⁴² NACP, 326 Records of the Atomic Energy Commission, Entry A1 19, Minutes of the Meetings of the AEC, Box 14, Meeting No. 1675, 23 November 1960, 878-879.

existed—either concentrate wastes so these could be contained or dilute wastes so these could be dispersed. The section then proceeded to describe the “waste management methods” at several different AEC installations—a nuclear power plant (the Shippingport, PA Atomic Power Plant), a production and processing installation (Hanford Works, Hanford, WA), a development laboratory (Brookhaven, NY), and also disposal methods by sea and land burial.⁴³ Examining these three facilities sheds light on the overall thought patterns of the AEC.

The Shippingport facility, located on the Ohio River in Pennsylvania, is credited as the first nuclear power plant devoted solely to peaceful production of atomic power. The 400-acre site used pressurized water as a reactor coolant and in the process built up low-level radioactive waste from both corrosion processes and from fission products produced by occasional fuel ruptures, and it also produced high-level wastes from the actual nuclear fuel. High-level wastes were shipped to an unnamed AEC site, and low-level wastes got reduced in concentration and discharged directly into the Ohio River, supposedly not to exceed one-tenth the maximum possible concentration. To ensure that the radioactivity of these lower level wastes did not excessively pollute the river, the facility stored the liquids in large underground tanks for around forty-five days. The total “reactor-waste effluent” was about 23,000 gallons per month with radiation around three microcuries per milliliter. In 1956 the Commission began an off-site monitoring program for changes in air, soil, and vegetation in the area and also monitored well water within a mile of the site.⁴⁴ As at other sites, whenever possible the AEC discharged radioactive

⁴³ On top of disposal at these facilities, the AEC also licensed nine total companies, four for the first time that year, all for “disposal of low-level waste commercially.” *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 124, 304-306.

⁴⁴ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 306-308.

products directly into the local environment, and when this was not possible stored that waste until such a time as it could be directly deposited into the environs, even if that day would never come.

The Hanford Site was 650 square miles in 1960, “located in a saucer-like basin surrounded by hills and mountains up to 3,600 feet above sea level” on the Columbia River in Southeastern Washington.⁴⁵ One press release described Hanford as “constructed in this isolated expanse of wasteland” (yet, on the next page it described the people who lived near the plant).⁴⁶ There is a plateau in the basin where most of the plant is located, and the semi-arid area was lightly populated at the time. A good thing, too, because as of January 1960 the Hanford plant had “discharged to the environment about 95% of all low- and intermediate-level radioactivity so disposed of in the United States through atomic energy operations,” making it a natural choice for study in the report. One of the interesting things about Hanford, though, is that the disposal techniques used there depended on the site’s unique location and geography, and as such would not necessarily work elsewhere. Eight reactors at Hanford produced plutonium for nuclear weapons, and those reactors had to be cooled by water from the Columbia River that became contaminated by ambient radiation in the reactors. Prior to being released back into the Columbia River, the facility held the effluent in tanks for one to three hours, which

⁴⁵ One of the more interesting maps of Hanford is located on the back of a letter sent to President Eisenhower. It not only shows Hanford situated between the Yakima and Columbia Rivers, but also includes lots of agricultural drawings, such as tractor, barn, wheat, cattle, fruit, etc. In addition, the map also portrays the Phillips Chemical Anhydrous Ammonia plant, the Boise-Cascade Co. Container Plant Pulp & Paper Mill, a Junior College, dams, and oil pipelines. In this way, the map depicts a melding of natural and hummanmade parts of the local environment very reminiscent of Richard White’s *Organic Machine*, also about the Columbia River. Obviously this map came decades before White’s book. DDEL, White House Central Files, General File, Box 1214, Folder 155, 1958, Map of Hanford. Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995)

⁴⁶ HSTL, Papers of Truman, President’s Secretary’s Files, Box 174, Folder Atomic Bomb, Press Releases [1 of 3], War Department Press Release on Hanford Engineer Works, 1-2.

reduced the radioactivity by 50-70 percent. The report claimed, “By the time the effluent has traveled to the vicinity of Pasco, 35 miles downstream, and the first point of substantial use, further radioactive decay has reduced the gross activity by a total of about 90 percent and well below the permissible limits for safe consumption.” Since the dilution of the Columbia is over 1.4 million gallons per second at places, this is unsurprising, but as Chapter Two demonstrated, determining “permissible limits” could be quite difficult and imprecise. Low-level cooling water with only minor radioactivity accounted for thirty billion gallons of the total waste produced, but other waste existed with potentially far more harmful effects.⁴⁷

The Hanford site produced a great many other radioactive wastes, some of them solids and others highly toxic liquids. Solid wastes like “contaminated paper, boards, worn out tools, construction items, and aluminum spacers” were buried in trenches, isolated from the environment with very little perceived risk of affecting the water table. Bigger solid items were buried in very deep pits or stored in large concrete-lined tunnels. Perhaps more importantly, Hanford had produced fifty-two million gallons of high-level radioactive waste, stored indefinitely in underground tanks of between one-half to one million gallon capacity. The report asserted, “No environmental hazard exists as long as the tanks maintain their integrity.” The site also created around three billion gallons of intermediate-level waste, “deposited to the ground under carefully controlled conditions.” For these, “Favorable geological and hydrological conditions in the area, and the capacity of the soil to absorb isotopes, make it possible to hold the vast majority of the radioactive materials in a thick layer of sediments. Thus, the wastes are essentially ‘stored’ in the ground, and any water percolating through to the water table is purified by time and the

⁴⁷ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 308-312.

action of the soil.”⁴⁸ Even though the local environmental conditions may have mediated the ways in which radioactive waste disposal occurred at Hanford, the site still suffered from the same problems as anywhere else—the AEC produced a great deal of waste that had to go somewhere, and this meant that if it could not be put back into the natural world it had to be stored until such a time came (or never came) that the waste could be safely put back into the environment.

Finally, the report surveyed waste disposal at Brookhaven National Laboratory, a 3,600-acre site located at the center of Long Island, New York devoted to nuclear research. Most of the waste the laboratory produced came either directly or indirectly from the large air-cooled research reactor on site. “The off-gases from the hot laboratory are cleaned by filters and scrubbers and released through a pipe going up the center of the 310-foot stack provided for the reactor cooling air.” Radioactive argon 41 was the most significant radioactive product in the cooling air, but the stack spit the gas up very high, where presumably the radioactivity would not affect humans and could be diluted by the general air. Any liquid wastes were of a low level and “discharged to a sewerage system installed when the site was used for a large Army camp. The effluent passes through an Imhoff tank that removes most of the solids and then is discharged to a large sand filter, collected by an underlying tile field, chlorinated, and discharged to a small stream.”⁴⁹ Like at other sites, the AEC produced significant radioactive waste and thus had to disperse that radiation into the natural world, planned as carefully as possible so that such dispersal hopefully would not affect humans.

⁴⁸ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 313-317.

⁴⁹ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 317-320.

Apart from these three sites, more general waste disposal occurred both by land and sea burial. The report for 1959 stated, “Except for storage in rigorously maintained tanks, there is no waste management method that withholds radioactive wastes from the environment on an essentially permanent basis.” However, the AEC did not consider indefinite storage necessary for most wastes, as these would lose all radioactivity in a few years. “Land and sea burial are means of disposal intermediate between long-term storage and diluted release to the environment,” even if only low-level wastes can be buried in the ocean. Brookhaven, for example, did some sea burial. The laboratory reduced some of its wastes to solid form, sometimes with a solidifying agent like concrete, and from there essentially loaded the waste into fifty-five gallon drums, had trucks drive these to a wharf where the drums could be loaded onto ships and taken out 250 miles to sea and dumped overboard at depths of more than a mile. While other countries may have dumped liquid wastes directly into the sea, the AEC did not license such practices (even if waste could be unloaded directly into streams and rivers that flowed to the ocean). All told, tens of thousands of drums and hundreds of concrete boxes found a watery resting place this way.⁵⁰

Of course the AEC did not find waste disposal sufficient in its then current state, so the Commission enacted an “extensive, coordinated research and development program in all phases of waste control operations.” That research program’s three objectives were: “develop practical systems for the final disposal, or long-term management, of highly radioactive wastes associated primarily with the chemical reprocessing of irradiated nuclear fuels”; “evaluate quantitatively the dilution or concentration factors in nature in order to determine the degree of treatment required

⁵⁰ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 321-329.

prior to release of low-level wastes to the atmosphere, ground, or waterways”; and “obtain increased knowledge of the fundamental phenomena and processes involved in handling and disposal of radioactive wastes so that more efficient and economical systems may be devised.” The Commission recognized that high-level wastes would plague humans for hundreds of years, and thus needed to “be contained essentially at the point of disposal so that man, his environment, and his resources are not adversely affected.” Tank storage may have worked for fifteen years, but obviously did not represent true disposal “in the ultimate sense.” The Commission also recognized that its knowledge of “oceanic behavior” was inadequate, “and attendant engineering problems appear so complex for high-level wastes, that alternate systems that are easier to control directly are the most likely solution.” Other research existed as well into every different type of wastes at all radioactivity levels.⁵¹

Thus the 1959 AEC report to Congress showed two things—the Commission cared a great deal about how disposal happened and sought to improve that, and yet, for all the research and care paid to such matters it still lacked practical solutions for some wastes with the realization that such answers might never exist. The AEC report to Congress for 1960 reported that, in 1959, the United States had produced fifty-four million gallons of high-level wastes.⁵² Considering that no solution yet existed for high-level wastes other than storage, this represented an incredible liability for both the AEC and the United States. Moreover, those many millions of gallons of deadly sludge serve as a fitting symbol for the conundrum that is nuclear waste disposal. Many fantastic and incredible feats can be accomplished through nuclear technology, but almost all of them

⁵¹ *Annual Report to Congress of the Atomic Energy Commission for 1959, January 1960*, 335-339. On the other types of research, see 339-367.

⁵² *Annual Report to Congress of the Atomic Energy Commission for 1960, January 1961*, 86.

produce nuclear wastes that range from mildly dangerous to horribly toxic. Once the wastes are produced, there is nothing humans can do to reduce the inherent radiation other than wait for it to decay over several half-lives, some of which can take much longer than any human lives.

It is fitting, then, if incredibly unfortunate, that the legacy of nuclear waste disposal policies has outlived essentially every policymaker from the early Cold War era. In February 1986 the U.S. public learned through a Freedom of Information Act request that the Hanford facilities in southeastern Washington State had pumped millions of curies of radiation into the local environment. Hanford was created to help produce the plutonium deemed necessary for the atomic bombs used to win World War II and the Cold War—to safeguard the United States and its people. It clearly, at times, had the opposite effect. And in a situation reminiscent of the decisions of even AEC Commissioners, Hanford's top decision makers sometimes intentionally sacrificed human safety for the sake of easier public relations.⁵³ At another site, the Lake Ontario Ordnance Works in western New York State, “a spirit of patriotic sacrifice, combined with a culture of secrecy, overrode concerns about safety.” The site was a TNT plant during World War II, converted to a radioactive dumping ground in 1944, and variously sold back in pieces to both public and private entities in the 1950s and 1960s. All the while, contamination

⁵³ “Hanford’s chief health physicist Parker repeatedly advised against closing public fishing and hunting near the reservation [even when tests showed potential dangers from radiation]. ‘The possibility of damage exists,’ he said [in 1954]. However the potential hazards were ‘overshadowed by the public relations effect... The relations situation is always potentially dangerous, and it will be severely taxed if and when actual restrictions...on sport fishing are recommended.” Michele Stenehjem wrote that scholars particularly needed to pay attention to this story, because “If we do not look clearly at the terrible environmental contamination generated at the Hanford Nuclear Reservation, then our nation may remain vulnerable to the poisonings and pollution of other projects and technologies born and carried on under the cloaks of secrecy and national security.” Michele A. Stenehjem, “Pathways of Radioactive Contamination: Beginning the History, Public Enquiry, and Policy Study of the Hanford Nuclear Reservation,” *Environmental Review*, Vol. 13, No. 3/4 (Autumn-Winter, 1989), 105-106, 109-110.

by nuclear waste created incredible human and environmental health dangers that last even through current-day cleanup operations.⁵⁴

Typically waste disposal in the United States, during both the early Cold War and current times, has produced an “out of sight, out of mind” mentality among U.S. citizens and policymakers, but such a mindset clearly does not make sense when applied to nuclear waste. The country’s top decision makers relied on scientific knowledge to deal with the sizeable problem of radioactive waste disposal. Tens of billions of gallons of low-level waste represented no significant obstacle, but still polluted the nation’s rivers and soils and the global oceans. All the country had was hopes and assurances (not all born out or true) that such contamination would not permanently harm U.S. environments or peoples. The other tens of millions of gallons of waste—high level contaminated waste—could be stored more or less safely in gigantic vats, but required complete removal from the environs or else great biological destruction would occur. Previous ways of thinking about trash may have worked for previous types of trash (or at least caused less acute problems), but when applied to nuclear waste caused problems. The AEC consistently talked about the limits to how much radiation could and could not be placed into the natural world, but perhaps a better way of thinking would have been to question whether any extra radiation should be permitted into the lands and bodies of U.S. peoples. But doing so would have necessitated reconsidering the activities that produced such radiation; something the AEC was not willing to do.

⁵⁴ Andrew Jenks, “Model City USA: The Environmental Cost of Victory in World War II and the Cold War” *Environmental History*, Vol. 12, No. 3 (Jul., 2007), 552.

Conclusion: The Nuclear Complex, Decision Making, and Environmentalism

“Environmentalism,” Historian Hal Rothman contended, “is one of the most important new dimensions to appear in American society in the post-1945 world. Part social movement, part manifestation of the increasing affluence and privilege of American society and different from the conservation movement that preceded it, environmentalism took center stage in the transformation of the values and mores of the second half of the twentieth century.”¹ And yet, even though environmentalism has clearly played an important role in postwar United States society, both popular and scholarly understandings of the idea are imperfect. Cultural scholar Raymond Williams defined environmentalism as “concern with the human and natural habitat” or “the doctrine of the influence of physical surroundings on development.”² Yet more common definitions eschew such a value-neutral characterization and place emphasis on protecting the environment at the expense (or detriment) of other considerations, such as economic or political concerns.³

This conclusion asserts that perhaps our understanding of what “environmentalism” is and who should be considered “environmentalist” has skewed

¹ In *The Greening of a Nation?*, Rothman chronicled the transition in the United States from a conservationist perspective into an environmentalist one, and then ruminated on what environmentalism had meant and could mean for the country. Hal K. Rothman, *The Greening of a Nation? Environmentalism in the United States Since 1945* (Fort Worth: Harcourt Brace & Company, 1998), XI.

² Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (New York: Oxford University Press, 1976, 1983), 111.

³ Michael Shellenberger and Ted Nordhaus have criticized this aspect of environmentalism and called for a reexamination of what it means to be an environmentalist in their article, “The death of environmentalism.” They contend, “the environmental community’s narrow definition of its self-interest leads to a kind of policy literalism that undermines its power.” Similar to what this essay attempts to do, yet for very different reasons, Shellenberger and Nordhaus attempted to redefine what should be considered “environmentalist.” Michael Shellenberger and Ted Nordhaus, “The Death of Environmentalism: Global Warming Politics in a Post-Environmental World.” The essay was first released at an October 2004 meeting of the Environmental Grantmakers Association and can be found online here, for example: http://www.thebreakthrough.org/PDF/Death_of_Environmentalism.pdf

how we evaluate the environmental records of those in political power.⁴ Government officials during the Truman and Eisenhower administrations frequently prioritized scientific understandings about the natural world when making policy decisions about the nuclear complex, but did not do so in ways that would be recognized as environmentalism by most people. Neither scholars nor the general public have appreciated this attention to environmental considerations exhibited by these early Cold War decision makers. The studied policymakers did make decisions that caused a great deal of harm to the environment. They also, however, continuously integrated environmental science into their decisions and used their ever-improving knowledge about the environment to help them make what they considered to be the best possible choices for their nation and the people in it. This thoughtfulness about environmental issues has been unrecognized by scholars and, if considered relative to Raymond Williams' definition of environmentalism as "concern with the human and natural habitat" or "the doctrine of the influence of physical surroundings on development," could be called a sort of environmentalism (or proto-environmentalism, considering they held office before the advent of the environmentalist movement).

⁴ On the environmental records of presidents, especially Truman and Eisenhower, see: Byron W. Daynes and Glen Sussman, *White House Politics and the Environment: Franklin D. Roosevelt to George W. Bush* (College Station: Texas A&M University Press, 2010); Riley E. Dunlap and Michael Patrick Allen, "Partisan Differences on Environmental Issues: A Congressional Roll-Call Analysis," *The Western Political Quarterly*, Vol. 29, No. 3 (Sep., 1976); Elmo Richardson, *Dams, Parks & Politics: Resource Development and Preservation in the Truman-Eisenhower Era* (Lexington: The University Press of Kentucky, 1973); Roderick Nash, Review of *Dams, Parks & Politics: Resource Development and Preservation in the Truman-Eisenhower Era* by Elmo Richardson. *The American Historical Review*, Vol. 80, No. 2 (April 1975); Susan Hunter and Victoria Noonan, "Energy, Environment, and the Presidential Agenda," in *The Presidency Reconsidered*, Richard W. Waterman, ed. (Itasca, F.E. Peacock Publishers, Inc., 1993); Dennis L. Soden, "Presidential Roles and Environmental Policy," in *The Environmental Presidency*, Dennis L. Soden, ed. (Albany: State University of New York Press, 1999); Carolyn Long, Michael Cabral, and Brooks Vandivort, "The Chief Environmental Diplomat: An Evolving Arena of Foreign Policy," in *The Environmental Presidency*, Dennis L. Soden, ed. (Albany: State University of New York Press, 1999); Dennis L. Soden and Brent S. Steel, "Evaluating the Environmental Presidency," in *The Environmental Presidency*, Dennis L. Soden, ed. (Albany: State University of New York Press, 1999);

Environmentalism-like care for the environment in the United States was nothing new by the mid-twentieth century. From efforts to save the American bison in the fin-de-siècle era to Progressive Era conservationism, explicit concern for the environment increased dramatically from the late nineteenth century to World War II (WWII).⁵ In historian Donald Worster's estimation, a particular moment during WWII—the detonation of the world's first atomic bomb on 16 July 1945 in the New Mexico desert—marked the beginning of the “Age of Ecology.”⁶ And just a few years after that, in 1949, famed forester and environmental thinker Aldo Leopold's seminal *A Sand County* *Almanac* posthumously appeared a year after his death.⁷ By many accounts, however, the environmental age truly began sometime around the 1962 publication of Rachel Carson's *Silent Spring*, the text that served as a call to action for many budding environmentalists of the 1960s.⁸ Taking after the lessons provided by Carson and previous thinkers,

⁵ On efforts to save the American Bison, particularly by the American Bison Society, see Chapter Six, “The Returns of the Bison,” in Andrew C. Isenberg, *The Destruction of the Bison: An Environmental History, 1750-1920* (New York: Cambridge University Press, 2000). On Progressive-Era conservation, though it is more of a work on politics at the time than environmental understandings, see: Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Pittsburgh: The University of Pittsburgh Press, 1959, 1999). And many workers knew for years in their bodies the importance of the environment and its health to the health of their own bodies. Linda Nash, *Inescapable Ecologies: A History of Environment, Disease, and Knowledge* (Berkeley: University of California Press, 2006)

⁶ In *Nature's Economy*, Worster quoted the “father” of the atomic bomb, J. Robert Oppenheimer, as quoting the *Bhagavad-Gita* at that moment, “I am become Death, the shatterer of worlds.” Donald Worster, *Nature's Economy* (San Francisco: Sierra Club Books, 1977), 339.

⁷ Aldo Leopold, *A Sand County Almanac, And Sketches Here and There* (New York: Oxford University Press, 1949, 1987)

⁸ Al Gore wrote in the introduction to the 1994 reprint of the book, “*Silent Spring* came as a cry in the wilderness, a deeply felt, thoroughly researched, and brilliantly written book that changed the course of history. Without this book, the environmental movement might have been long delayed or never have developed at all.” Al Gore, “Introduction,” in Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin Company, 1962, 1994), xv. For an example of the importance of *Silent Spring*, historian Edmund Russell wrote that Carson's work “helped catalyze the modern environmental movement by characterizing pest control as a self-defeating form of warfare.” Russell even used *Silent Spring* as the endpoint for his historical study. Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (New York: Cambridge University Press, 2001), 7. Ted Steinberg, as another example, said Carson changed “the terms of the debate over environmental reform” and “helped to transform *ecology* into the rallying cry of the environmental movement.” Ted Steinberg, *Down to Earth: Nature's Role in American History* (New York: Oxford University Press, 2002), 246-247.

ecological thinking and a desire to protect the environment have typically defined modern environmentalism as emerging sometime soon after the publication of *Silent Spring*.

This dissertation, however, has shown a much more nuanced notion of what concern for the environment might look like and perhaps also calls us to reevaluate who we might call environmentalist and who we should not. Presidents Truman and Eisenhower would rarely, if ever be called environmentalists by current definitions. Moreover, since they lived before the environmental movement began, deeming either an environmentalist is probably anachronistic. Top policymakers from their administrations, however, spent a considerable part of their time thinking about the natural world while making decisions about the nuclear complex. Sometimes those decisions, such as dumping nuclear waste into the global oceans, were harmful for the natural world. At other times, these men made decisions with the express intent of trying to protect the environment, such as nuclear test cessation talks during Eisenhower's second presidential term. Either way, many of their choices reflected not only a deep recognition of the power humans hold over the environment, but also a perception of how the natural world affects human plans and desires. These understandings were not always conscious or well thought out, but policymakers nonetheless took the environment into account when evaluating the best ways to develop the nuclear complex.

Deliberations by policymakers on the interaction between the environment and the nuclear complex occurred in many different ways. During nuclear tests, weather proved influential in determining when tests occurred and what happened when these did. Nuclear weapons also could have incredible effects on the natural world, and studies and surveys of the environs surrounding bomb test sites show that testers did develop a

comprehension of that. After tests, scientists gained an evolving knowledge of the radioactive fallout produced, and the ways decision makers used these scientific understandings of fallout reflect a developing but innate understanding of an interconnection between human health and the environment. That comprehension proved crucial in the later years of Eisenhower's presidency when he and others sought to end nuclear weapons tests, as concern for the natural world and knowledge of it were critical to those talks. Atomic agriculture and nuclear waste disposal practices provide further evidence for the interconnected nature of decision making, environment, and the nuclear complex. We cannot understand the nuclear complex without understanding how the natural world affected its early development, whether policymakers held an environmentalist sentiment to protect the natural world or not.

This is, of course, not to say that involving the natural world and understandings of it into nuclear policymaking meant protecting the environment at all costs. Geopolitical and natural security priorities caused top decision makers to weigh their concerns for the nation and decide what they thought was in the country's best interest. Sometimes protecting the nation meant developing natural resources or preserving human health via keeping the environment free from nuclear pollutants. At other times, however, fear of Soviet military aggression meant such environmental concerns should be sacrificed in the name of national security. Moreover, many examples throughout the dissertation of how nuclear waste dumping went into Mexico or how radioactive fallout affected non-U.S. peoples clearly demonstrate that U.S. policymakers almost always cared overwhelmingly and only about the United States and its environments (or, more likely U.S. citizens, residents, and voters). And since tropospheric fallout tends to stay in

similar latitudes, tropical peoples tended to suffer disproportionately from the fallout produced by tropical nuclear tests at the Pacific Proving Grounds.

Even considering the holes in their concern for the environment and its peoples, Truman and Eisenhower-era officials did understand that the natural world affected their plans, aims, and goals and incorporated environmental knowledge into their policymaking. In its own way, is this not a form of environmentalism? Perhaps we need to redefine environmentalism into more neutral terms that do not ascribe certain policy goals and also allow for other concerns to sometimes take precedent over protecting the environment. In 2012, Roger V. Scruton argued that conservatives and Republicans in the United States represented the nation's true environmentalists and thus needed to resurrect their environmentalist credentials and reclaim that moniker from liberals and Democrats.⁹ And yet, a February 2013 Google search of "EPA [Environmental Protection Agency] job killing regulations" yielded almost 1.4 million hits, with the top hits all either being from a conservative perspective or responding to one. Considering such viewpoints, perhaps conservatives should not look to Scruton's arguments for ways that conservatives can be environmentalists, but instead look to the practical environmentalism displayed by Dwight Eisenhower, whose policies did not demonstrate thinking based on a zero-sum dichotomy between environment and economics.

While conservatives might be able look to Eisenhower as a model for how to incorporate the environment into their politics, perhaps most liberal environmentalists can learn that the integration of environmental knowledge and understandings into policy

⁹ Scruton, a former professor of aesthetics at Birkbeck College, London, wrote a text on the issue titled *How to Think Seriously About the Planet: The Case for Environmental Conservatism*. Paul Basken, "Scholar of Aesthetics Hopes to Show Conservatives Their Inner Environmentalist," *The Chronicle of Higher Education*, 5 June 2012.

will not always yield the results they hope. The inclusion of environmental knowledge into policy will not, as this dissertation has shown, necessarily lead to increased protection of the natural world. Policymakers are forced, by the nature of their positions, to balance a great many concerns at once. Just because they spend more time thinking about the interaction between their plans and the natural world it does not mean they will take a stance that would be commonly perceived as environmentalist.

Perhaps the greatest conclusion to be taken from this dissertation, then, is a call for scholars and the public alike to rethink the utility of our current definitions of environmentalism, especially in a policy context. Early nuclear complex policymakers started off thinking about the natural world's importance to the nuclear complex for principally non-ecological reasons—human health, effects on military operations, how agriculture could be improved, etc. Eventually, however, more of an environmentalist perspective developed in U.S. policymakers, even if that new ethos had to be placed within a geopolitical context of protecting the nation. The nuclear complex, like many parts of human society, owes a great deal of its development to the natural world. Policymakers who made decisions about the nuclear complex also understood this, even if frequently only on an unconscious level. Some of them, on the other hand, expressed similar ideas quite explicitly. In 1953, Commissioner Thomas E. Murray spoke at the Seattle University Commencement and said:

Tornado and earthquake and resulting conflagration have long been called acts of God because man, humble in the consciousness of his own limitations, has until this decade recognized them as beyond his capacity to produce or control. [...] Today man is more powerful. He can, as it were, generate hurricanes, earthquakes, and consuming fires. He can today open the tight doors of the atom and let forth all three – wind, earthquake, and fire – in such a manner as to make Hiroshima's atomic attack look like a Civil War bombardment. Because of the limitless nature of our destructive potential power we must moderate our forceful

capabilities with something of the meekness and patience of the Saints. We must learn something of God's contempt for the great and the mighty – something of His preference for His little ones.¹⁰

Even ignoring the religious overtones and delusions of grandeur, Murray clearly saw humans as occupying a strange place between controlling the natural world, being more powerful than it, and yet still being subject to the whims of environmental vagaries.

The nuclear complex and decision making from 1945-1960 provide clear examples of the importance of the environment to politicians from all sorts of political perspectives. The case at hand thus not only reminds us that the environment is more important to societal structures than is commonly realized, but also demonstrates that policymakers from all walks can legitimately incorporate concerns about the natural world into their policy considerations and still hold firm to their most important political and economic values. In fact, caring about the environment often can be an important part of staying true to such ideals. If we can learn from the example of policymaking about the nuclear complex and the environment then perhaps we can better understand how we should, as conscientious, thinking humans, interact with the environment when we build our societies and try to live good lives.

¹⁰ DDEL, White House Central Files, Official File, Box 213, Folder 8, Commencement Address by Thomas E. Murray at Seattle University, Seattle, WA, 29 May 1953, 3-4.

Appendix One: AEC Commissioners, 1946-1960¹

AEC Chairmen	Dates Served
David E. Lilienthal	(1 November 1946 – 15 February 1950)
Gordon E. Dean	(11 July 1950 – 30 June 1953)
Lewis Strauss	(2 July 1953 – 30 June 1958)
John A. McCone	(14 July 1958 – 20 January 1961)
 Other Commissioners	 Dates Served
Robert F. Bacher	(1 November 1946 – 10 May 1949)
Sumner T. Pike	(31 October 1946 – 15 December 1951)
William W. Waymack	(5 November 1946 – 21 December 1948)
Lewis L. Strauss ²	(12 November 1946 – 14 April 1950)
Gordon E. Dean ³	(24 May 1949 – 11 July 1950)
Henry D. Smyth	(30 May 1949 – 30 September 1954)
Thomas E. Murray	(9 May 1950 – 30 June 1957)
T. Keith Glennan	(2 October 1950 – 1 November 1952)
Eugene M. Zuckert	(25 February 1952 – 30 June 1954)
Joseph Campbell	(27 July 1953 – 30 November 1954)
Willard F. Libby	(5 October 1954 – 30 June 1959)
John Von Neumann	(15 March 1955 – 8 February 1957)
Harold S. Vance	(31 October 1955 – 31 August 1959)
John S. Graham	(12 September 1957 – 30 June 1962)
John F. Floberg	(1 October 1957 – 23 June 1960)
John. H. Williams	(13 August 1959 – 30 June 1960)
Robert E. Wilson	(22 March 1960 – 31 January 1964)
Loren K. Olson	(23 June 1960 – 30 June 1962)

¹ Adapted from: Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947/1952: Volume II of A History of the United States Atomic Energy Commission* (University Park: The Pennsylvania State University Press, 1969), 664, and Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley: University of California Press, 1989), 569.

² Came back in 1953 as Chairman.

³ Served this time as a Commissioner before becoming Chairman on 11 July 1950.

Appendix Two

Selected Timeline of Early International Test Ban Events **(Adapted from the Federation of American Scientists¹)**

1945

16 July: The United States conducted the world's first nuclear weapons test, code-named Trinity, at Alamogordo, New Mexico.

1949

29 August: The first Soviet nuclear test is conducted at a test site near Semipalatinsk in Kazakhstan

1954

1 March: The United States conducted a massive hydrogen bomb test that released previously unfathomable amounts of radioactive fallout into the Earth's atmosphere. The incident particularly drew international attention because fallout rained over the Japanese fishing vessel *Lucky Dragon* and also inhabitants of the Marshall Islands. After this moment, the world became more attuned to issues of fallout in the atmosphere.

1957

21 August: U.S. President Dwight D. Eisenhower announced that the United States would be willing, as part of a first-step disarmament agreement, to suspend testing of nuclear weapons for up to two years under certain conditions and safeguards. These included Soviet acceptance of the U.S. call for a permanent cessation of the production of fissionable materials for weapons purposes and the installation of inspection systems to ensure compliance.

1958

31 March: The Soviet Union announced that it would unilaterally halt all nuclear tests provided Western nations also stop testing.

8 April – 21 August: President Eisenhower proposed a Conference of Experts to examine the issues involved in verifying a nuclear test ban. The conference convened on 1 July in Geneva with scientists from the United States, Britain, the Soviet Union, France, Canada, Czechoslovakia, Romania, and Poland. On 21 August, the conference released a report indicating that a comprehensive nuclear test ban could be verified through a network of 160 monitoring stations and that nuclear tests in space out to 50 kilometers also could be verified, but that current technology could not detect tests in deep space.

¹ "Comprehensive Test Ban Treaty Chronology," Federation of American Scientists' website, <http://www.fas.org/nuke/control/ctbt/chron1.htm>, accessed 13 February 2012

22 August: President Eisenhower announced that the United States was prepared "to negotiate an agreement with other nations which have tested nuclear weapons for the suspension of nuclear weapons tests and the establishment of an international control system." If this proposal were accepted in principle by the other nations that have tested nuclear weapons, "then in order to facilitate the detailed negotiations, the United States [was] prepared, unless testing [was] resumed by the Soviet Union, to withhold further testing on its part of atomic and hydrogen weapons for a period of one year from the beginning of the negotiations."

31 October: The United States, Britain, and the Soviet Union began negotiations on a comprehensive nuclear test ban at the Geneva Conference on the Discontinuance of Nuclear Weapons Tests. The United States and Britain began a one-year testing moratorium, which the Soviet Union joined a few days later.

1959

13 April: In a letter to Soviet Premier Nikita Khrushchev, President Eisenhower offered an alternative approach to a nuclear test ban: If the Soviet Union insisted on a veto over an on-site control system to monitor underground detonations, the two sides could implement a test ban in phases, starting with a prohibition of nuclear weapons tests in the atmosphere up to 50 kilometers. Meanwhile, the negotiations could continue to resolve the political and technical problems associated with control of underground and outer space tests. Premier Khrushchev rejected the proposal ten days later and suggested instead a complete test ban with a predetermined number of on-site inspections.

5 May: In another letter to Premier Khrushchev, President Eisenhower urged technical discussions on the possibility of banning nuclear tests to a greater atmospheric height than that mentioned in his 13 April letter. The president again urged the Soviet Union either to accept the control measures that would make possible a complete ban on nuclear weapons tests or to agree to the U.S. proposal for a partial ban. The president stated that the United States was prepared to explore Premier Khrushchev's proposal for a predetermined number of inspections in the territory of the United States, Britain, and the Soviet Union, but added that the number should be related to scientific facts and detection capabilities.

26 August: President Eisenhower extended the voluntary one-year suspension of nuclear weapons testing by the United States to 31 December 1959.

28 August: The Soviet Union stated that it will not resume nuclear testing provided the Western powers continue to observe a moratorium.

29 December: President Eisenhower announced that when the U.S. nuclear testing moratorium expired at the end of 1959, the United States would "consider ourselves free to resume nuclear testing," but would not resume testing without advance notice.

1960

1 May: U-2 reconnaissance plane was shot down over Sverdlovsk in the Soviet Union. Premier Khrushchev canceled a scheduled four-power Paris summit, and no further progress was made in the complete test ban negotiations for the balance of the Eisenhower administration.

1963

15 July – 5 August: The United States, Britain, and the Soviet Union negotiate and sign on 5 August the Limited Test Ban Treaty outlawing nuclear tests in the atmosphere, in outer space, and underwater. Underground tests are also outlawed if they result in spreading radioactive debris outside the territorial limits of the state where the explosion is conducted. The treaty enters into force on 10 October 1963.

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Dwight D. Eisenhower Papers as President, Ann Whitman File

Administrative Series

Cabinet Series

Campaign Series

Diary Series

Press Conference Series,

Speech Series

John Stewart Bragdon Records, Miscellaneous File

John Foster Dulles Papers, General Correspondence and Memoranda Series

John A. McCone Papers

White House Central Files

Confidential Files

General File

Official File

Official File, Cross Reference Sheets

White House Office, Office of the Special Assistant, OCB Series

Administrative Subseries

Subject Subseries

Harry S. Truman Presidential Library (HSTL)

Atomic Bomb Collection

Dean G. Acheson Papers

Papers of Clark Clifford, Subject File

Papers of David D. Lloyd, General Correspondence File

Papers of George M. Elsey

Papers of Harry S. Truman

Official File

President's Secretary's Files

White House Central Files, Confidential Files

The National Archives at College Park, MD (NACP)

RG 326 Records of the Atomic Energy Commission

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